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EDITORIALS

ONE ENGINEER WHO GOT CREDIT

In this issue the story of how one engineer got, and will continue to get, credit for his work is related. The article is entitled: "The O'Shaughnessy Dam and Its Dedication." There is much in it to entertain and instruct the reader. While considerable engineering information of value is given it is because of the human interest of the story that it is recorded in our pages. The article is of value also for its account of the pulling and hauling indulged in for many years between the interests who favored and those who opposed the Hetch Hetchy project. The article, while long, is intensely interesting. Its reading suggests many lines of thought which we leave for our readers to discover according to their several abilities in the realm of discovery.

THE TAX BURDEN

We read much these days of the burden of taxation. That taxes are high no one will deny, but there is much to be said in justification of present high taxes and of prospective higher taxes.

It is only natural that where discussion of a subject is long continued the discussion increases in intelligence as it progresses. This is true of the discussion of taxation. Newspaper editorials on the subject are growing fairer and better. This is due, in part, to the fact that when a newspaper's pet politician or pet party gets into power on the strength of impossible promises of lower taxes and then is obliged to increase taxes the newspaper has no way out but to justify the increase and to show why it is inevitable. Since taxes started to increase almost everybody has had a chance to reduce them but the result has been the same in all cases, namely, a large or small increase each year over the year before. And so it has come about that those who make any pretense of sincerity are getting away from the calling of hard names and are getting down to serious study of the subject and to honest effort to make the whole problem better understood.

As we understand it, taxes have always been a "burden," fancied or real. This was true when taxes were insignificant compared with what they are today. A man dislikes to pay his taxes because he is handing over some of his money for somebody else to spend. He will cheerfully squander many times the amount of his taxes and have a perfectly fine time doing it even though he is positively injured in the process. But he has not been taught that government takes some of his money and spends it for him, to his advantage, better than he could do it for himself. Such abuses as exist in the levying of taxes, and they have been many and long continued, have been due to the unwillingness of the people to understand the need for and purpose of taxation. For this reason taxes have always been as indirect as they could be made. They have been covered up in a thousand clever ways so that a man might pay them painlessly. The trend toward direct taxation is the most encouraging evidence of progress in this matter. Thus we have the income tax, the gasoline tax, the meter rate in utility service, all forms of direct taxation, and, generally speaking, fairly popular where understood.

In the past the ideal tax from the standpoint of the citizen has been a tax he escaped and the other fellow paid. The ideal tax from the standpoint of the public official has been one which could be collected easiest, that is, with a minimum of unpleasant noise and at the expense of as few new political enemies as possible. Thus Mr. Baldwin, British prime minister, recently said that while theoretically taxes were levied according to ability to pay, actually they were based on "getting the greatest quantity of feathers from the geese which squawk the least."

Almost every kind of experiment has

been tried repeatedly in the effort to extract taxes painlessly. There have also been many freak laws tried. It is said that England once tried a window tax. The owner of property paid taxes according to the number of windows in his house; then men, as reluctant then as now to pay taxes and as desirous of evading them, began building houses with fewer windows, with concealed windows, and even with no windows at all. This killed the window tax and probably something equally silly was next given a trial.

The luxury tax has always been highly regarded by the tax layers. About 40 years ago the bulk of the revenue of the United States government came from what President Garfield called "volunteer taxes." They were imposed on liquor and tobacco and only those who used liquor and tobacco paid. The decision rested with the citizen whether he should make himself liable and it is not recorded that many elected to evade payment of the tax. Those who wanted tobacco would have it at any price, even if a small part of the price went to the government in the form of a tax. The same was true in the case of liquor, only, perhaps, more so, for after a man had had a couple of drinks he became so generous that he did not mind giving his money away, even if the government got a little of it. The rest of the federal tax at that time came from the tariff which was popular, then as now, because those who paid it didn't know they paid.

Some may be inclined to question the statement made earlier in this discussion that there is a trend toward direct taxation and that it is popular. Take the case of the income tax. The first income tax law was enacted in the second Cleveland administration; it was declared unconstitutional. During the sixteen years following, with the other party in power, the law was allowed to remain dead. With the return to power of the party of Cleveland another federal income tax law was passed which still remains on the statute books despite the fact that the opposition party has again come into power and has had full control of the government for over two years. This shows clearly that while many are bitterly hostile to the income tax and while very few enjoy paying it, that it is considered fair in principle by such a large majority of the people that its repeal is not seriously considered at this time. Then there is the gasoline tax that requires a man to pay in proportion to his use of the highways. This is spreading rapidly despite serious opposition when it is first proposed in any state. After trying this tax it is approved almost universally. A direct tax, fairly levied and fairly collected, is no longer repugnant to a majority of the American people.

Of course the war, directly and indirectly, greatly increased our taxes and this influence will continue to keep taxes up for a good many years, even though we do not have another war in the meantime. But of equal, or greater, importance is the fact that people are demanding more and more improvements of all sorts and more service from government, thereby inevitably increasing taxes, especially so when taxation is openly rather than covertly levied. Many are becoming reconciled to this in the recognition of the fact that we must pay for what we get, even if we get it from or through the government. Being unwilling to accept less but, rather, demanding more and more, it is coming to be realized that the day of low taxes, as once understood, is not likely soon to return. A saner view and a more wholesome philosophy, with respect to taxation, meanwhile is rapidly gaining headway. Without becoming lighter the tax burden may become less galling.

A REJECTED ADVERTISEMENT

Not long ago a well known secondary city in the Middle West offered for publication in this magazine an advertisement addressed to consulting engineers inviting them to indulge in a bidding tournament as a preliminary to the selection of one of them to serve the city in a consulting capacity. While we do not want to deny any city the benefits to be derived from advertising in this publication we felt that here the welfare of the engineering profession was paramount and rejected the advertisement. A letter was also written to the official who submitted the advertisement which attempted to discourage further recourse to this method of selecting a consultant. This note will serve as notice that all advertisements calculated to encourage consulting engineers to bid against each other will be rejected by this magazine. That practice is so likely to lead to poor or dishonest work, or both, that we do not wish to encourage it in any way.

SHOULD THE STATE PURCHASE SMALL TOWN BOND ISSUES?

By Keyes C. Gaynor, Consulting Engineer, 525 Trimble Bldg., Sioux City, Iowa.

Small communities often find it difficult to finance the necessary modern conveniences, such as sanitary sewers and water works.

In many such towns these improvements are absolutely necessary from a sanitary point of view. Further, the small town at the present time has the fight of its life to retain its population and its business in competition with its larger neighbors already provided with modern improvements. The farmer of today who retires from the farm goes to that town where he can live in the greatest comfort.

The bond issues necessary to cover the cost of sewer and water works improvements are small and in many states, the legislature has limited the interest rate to 5% and further provides that the bonds must be sold at par. From the nature of things, it can be readily understood why the bond houses are not attracted to these issues. It costs just as much to handle a small bond issue as it does a large one. Therefore, the price of the small issue must be higher.

It has occurred to the writer, although he does not claim that the idea is original with him, that it would be of great advantage to the small town and also to the bond buyer, for the state legislatures to establish state financing departments, the purpose of which would be to buy the bond issues of the small towns and in turn issue bonds guaranteed by the state.

What Has Been Done in Nebraska

For instance, the State of Nebraska has accumulated many millions of dollars of so-called school funds. These funds have been invested in various ways, sometimes in bond issues of other states. Of late years, they have been investing these school funds in municipal bonds. During the years 1920-21 when the bond market collapsed, this was a wonderful aid to the small towns, and sometimes the towns were not so small either. Throughout this period, towns in Nebraska were able to carry out their construction programs and pay for them because the State bought their bonds

Need Shown in South Dakota

To show how such a plan would work, attention might be called to a case that recently came under the writer's observation. The City of Springfield, South Dakota which has a population of about 800 people recently voted $8,000 worth of water works bonds. Springfield is located in one of the best farming communities in South Dakota. The Southern State Normal School is located there. The town water supply has been derived from an artesian well. This supply is giving out and water must be obtained from some other source. When they advertised their bonds for sale, they could not get a bid which would conform with the law. Eastern bond buyers had never heard of Springfield, South Dakota, and could not take time to go out there and investigate so small an issue. If it had been possible for Springfield to sell these bonds to the State, the State of South Dakota could have turned around and sold State bonds, because everybody knows where the State of South Dakota is and what it is.

The carrying out of such a plan as suggested would not be a burden on the state, because the state could either sell 5% bonds at a premium or they could sell 4½% bonds and charge the town 5%. The difference in rate would provide money for the maintaining of the state financing department.

Such a plan as I have suggested would be welcomed by the small town and, I think, would be greatly appreciated by the bond buyers.

A DIFFERENT ANGLE ON THE SUB-DRAINAGE OF PAVEMENTS

By Monroe L. Patzig, Consulting Engineer, Patzig Testing Laboratories, Des Moines, Iowa.

Repeatedly our attention has been called to the necessity of providing adequate drainage for the soil underneath pavements. It doesn't seem, however, that this advice has been followed out to any great extent on municipal pavement construction. In certain localities at least, less drainage has been provided in recent years than was the practice, say, 15 years ago.

At that time crushed stone or gravel sub-drainage was required underneath the pavement foundation of concrete. In these same cities present day paving work is being placed directly upon the sub-soil no matter whether it be clay, loam, sand or other material. It was then also customary to require this type of drainage underneath sidewalks, curbs, etc.

There seems to be no dispute regarding the advisability or necessity of drainage excepting on the matter of determining

the actual necessity on each specific job. There is no positive method of determining when this added expense is necessary and economical. Necessity of sub-drainage is now largely determined by judgment of the soil conditions or a knowledge of the past behavior of the soil in question, which means that we are without adequate evidence, in most cases, to prove that sub-drainage will overcome certain destroying agencies and its expense is warranted.

Over a period of 20 years, actively engaged in pavement construction, the writer has had before him but one case where a systematic drainage system was provided. In this instance a system of drain tiles was laid in conjunction with the paving construction. It was afterwards necessary to prove that the drainage was necessary and could therefore be assessed as part of the pavement. An examination of the drainage outlet at a period several weeks after there had been any rainfall, revealed a flow of 5 ins. of water through the 20-in. outlet tile. From personal observation this soil did not appear to need drainage nearly so much as the pavement construction in many other localities where no drainage whatever was provided. This system of drainage was provided through the efforts of the engineer in charge, whose only proof as to its necessity was his judgment.

The effects of moisture in the soil have generally been recognized as causing a poor or yielding foundation, and upheavals, on account of frost or freezing.

Expansion due to moisture is still another effect, but given much less attention than the two mentioned.

My attention has often been called to cases of concrete pavements built during recent years, that had been badly warped. In most instances slabs of the pavement would be from 1 in. to 5 ins. higher than the adjoining slabs, and some of them were found to be curved or bent upwards as much as 3 ins. from a straight line.

Frequent examples exist where concrete used for pavement bases under such types of pavement as asphalt, brick, wood block, etc., have blown up and caused humps in the wearing surface. Some instances of these were actual explosions while most of them simply shattered the concrete underneath and caused unpleasant and objectionable humps in the pavement.

The causes of these disturbances had been attributed to heat expansion or frost action. I say heat expansion because where it was said to be due to expansion the only remedies suggested were to use expansion joints. If expansion due to moisture had been considered would it not be more effective to guard against the moisture or in other words, remove the cause? Surely this would be more positive, effective and practical.

Tending to substantiate this opinion let us consider the numerous instances of buckling experienced on asphaltic types of pavement, brick laid on sand cushion and other similar types. The concrete base in these instances is protected from the direct rays of heat, consequently there can be less possibility of heat expansion than of moisture expansion.

Also referring to the defects mentioned in the concrete pavements it appears that frost action would not cause the raising of one slab end over the adjacent one but would cause the two slab ends to come up instead of the one. Also temperature expansion would not cause one section rising over the other unless there was a distinct defect in making the joint by not making it perpendicular. But with moisture expansion there is a decided tendency for the concrete slabs to curl upwards due to the greater expansion on the lower surface than on the upper one.

This curling action can be more pronounced in concrete pavements than on the concrete base used under other types of pavement surfaces, because there can be a greater difference between the moisture or humidity of the two surfaces thereof.

Many sidewalks also show signs of this peculiar expansion and curling action.

In discussing this theory my attention was called to a cement slab which was carefully straight-edged during construction and was placed in a wall where dripping water had kept the backside thereof wet. In about a year's time this slab was discovered to be curved away from the wall.

The defects of concrete pavements and concrete foundations mentioned seem to occur more frequently in certain locations than in others. This is possibly due to the differences in soils and their water retaining tendencies.

They are also usually found to occur more frequently in cities and towns than upon highway pavements. This may be due to the fact that construction methods in cities and towns require the use of curbs and the ground elevations surrounding the pavement are higher, while standard highway practice permits the construction of open ditches or waterways on each side of the pavement, thereby af-

fording better outlets for the ground water underneath the same. Some of these same defects have, however, been noticed upon highways where wide earth shoulders, sometimes grown over with grass or weeds, were maintained, and the ground water thereby very likely retained under the pavement.

Believing, therefore, that moisture expansion has not been given the thought or study that temperature expansion and frost action have, it has been my purpose to mention this force for the purpose of arousing and encouraging more interest to the importance of drainage, and to create thereby a nation-wide discussion tending to bring about a definite and effective solution of the drainage problem affecting pavement construction.

It seems that a comprehensive study should be made of all kinds of soils tending to establish by some reliable methods of testing to determine the nature or tendencies of any soils to be used, in terms that are definite with respect to their actually requiring drainage or not requiring it. Also determination should be made with respect to the proper methods to be used for draining any such soils, effectively, efficiently and economically.

Realizing the extravagance of providing crushed stone, gravel or drain tile systems wherever clay soils are encountered, it is apparent that some exhaustive examinations, tests, analyses, research and discussion should be carried out in order to attempt a solution.

ILLINOIS COUNTIES JOIN STATE IN EXPERIMENTAL STUDY OF OILED ROADS

By H. F. Clemmer and F. L. Sperry, Engineer and Assistant Engineer of Materials, Illinois Division of Highways, State House, Springfield, Ill.

The Illinois Division of Highways in co-operation with the highway authorities of Henry and Christian Counties has started an exhaustive series of tests with the use of oil for the treatment of earth roads.

Soil and Climate Range

The construction of two experimental oiled roads has just been completed. One of these roads is located in the northwestern part of the State near Cambridge in Henry County. The other is located one mile from Rosemond near Pana in the south central portion of the State. These locations have been selected with the view of securing the fullest range of soil and climatic conditions which exist between northern and southern Illinois. The location of the experiments is believed to be of much importance because experience has indicated that both soil and climatic conditions are important factors in the life of an oiled earth road.

The Test Roads

The Cambridge Test Road is about 3 miles in length and comprises 15 sections, each 1,000 ft. in length. The Rosemond Road is about 2½ miles in length and comprises 16 sections, each 800 ft. long. Each of the 31 sections making up the two roads has been given a different oil treatment. Eleven different kinds and grades of road oil, including all available commercial varieties of oil having been used. Fourteen sections employing varying quantities of oil and numbers of treatments, varying from 1 quart per sq. yd. applied at one application to 1 gal. per sq. yd. applied at intervals throughout the season, have been constructed. Other sections have been constructed employing varying methods of maintenance and application of oil.

Both of the experimental roads are now open and subject to normal traffic conditions. The Rosemond Road is subject to only comparatively moderate traffic whereas the Cambridge Road carries a heavy automobile traffic. The roads are under close observation and their behavior will be carefully watched and the results of traffic recorded.

It is hoped by these experiments to secure much valuable data on the use of oil as a means of maintaining earth roads under conditions which exist in Illinois.

Experiment With Oil Applied in Varying Quantities and Numbers of Treatments

This series of tests occupies a total of 13 sections of both roads and covers the full range of treatments ordinarily used on dirt roads in Illinois, beginning with a minimum treatment of 1 quart per sq. yd. to a maximum of 1 gal. applied at intervals throughout the season. The same kind of oil was used throughout this series of tests except that the oil used at Cambridge was of a heavier grade than that used at Rosemond.

Descriptions of the individual sections follow:

Section 1-R*. Initial treatment, ¾ gal. per sq. yd. in three application. No further applications will be made on this section throughout the year. †Oil No. 1-R used. Total treatment, ¾ gal. per sq. yd.

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* "R" refers to the Rosemond road and "C" to the Cambridge road.

† For analyses and descriptions of oils see Table I.

Section 2-R. Initial treatment, ¾ gal. per sq. yd. in three applications to be followed by one similar application in the fall. Oil No. 1-R used. Total treatment, 1 gal. per sq. yd.

Section 3-R. Initial treatment, ½ gal. per sq. yd. in two applications to be followed by one similar application in the fall. Oil No. 1-R used. Total treatment, ¾ gal. per sq. yd.

Section 4-R. Initial treatment, ½ gal. per sq. yd. in two applications to be followed by one similar application in the late summer and another application in the fall. Oil No. 1-R used. Total treatment, 1 gal. per sq. yd.

Section 5-R. Initial treatment, ½ gal. per sq. yd. in two applications. No further application on this section. Oil No. 1-R used. Total treatment, ½ gal. per sq. yd.

Section 6-R. Initial treatment, ¼ gal. per sq. yd. to be followed by one similar application in the late summer and another in the fall. Oil No. 1-R used. Total treatment, ¾ gal. per sq. yd.

Section 7-R. Initial treatment, ¼ gal. per sq. yd. to be followed by one similar application in the fall. Oil No. 1-R used. Total treatment, ½ gal. per sq. yd.

Section 6-C. Initial treatment, ½ gal. per sq. yd. in two applications. No further applications to be made during the year. Oil No. 2-C used. Total treatment, ½ gal. per sq. yd.

Section 7-C. Initial treatment, one application of ¼ gal. per sq. yd. to be followed by one similar application in the fall. Oil No. 2-C used. Total treatment, ½ gal. per sq. yd.

Section 8-C. Initial treatment, one application of ¼ gal. per sq. yd. A similar application was made on August 8, 60 days after the initial treatment was applied. One further application will be made in the fall. Oil No. 2-C used for initial applications. Oil No. 8-C used for second application. Total treatment, ¾ gal. per sq. yd.

Section 9-C. Initial treatment, ½ gal. per sq. yd. in two applications. A similar application was made on August 8, 60 days after the initial treatment was applied. One further application will be made in the fall. Oil No. 2-C used for initial applications. Oil No. 8-C used for application made August 8. Total treatment, 1 gal. per sq. yd.

Section 10-C—Initial treatment, ½ gal. per sq. yd. in two applications to be followed by one similar application in the fall. Oil No. 2-C used. Total treatment, ¾ gal. per sq. yd.

Section 11-C. Initial treatment, ¾ gal. per sq. yd. in three applications. No further applications to be made during the year. Oil No. 2-C used. Total treatment, ¾ gal. per sq. yd.

Experiment With Different Kinds of Oil

In this series every commercially available kind or type of oil has been used. Nine sections are occupied by these tests.

By reference to "kind" of oil in these tests is meant a distinct chemical type of oil, according to the process of refining or the geographical source of the crude from which the oil has been prepared. By a "skimmed" oil is meant a residuum from a "skimming" plant, that is a refinery employing non-pressure or straight distillation methods of refining. A "cracked" oil is one which has been refined under the influence of high temperatures and pressures and thus chemically decomposed or "split" up into the lighter hydro-carbons and carbon to increase the gasoline yield. The term "cracked pressure tar residue" is applied to oils refined by a certain cracking process in which the residuum is so altered as to have many of the chemical characteristics of tar. "Mexican asphaltic oil, is oil obtained from Mexican petroleum which has a natural asphalt base and, therefore, is well adapted to road work and the manufacture of asphalt. "Cut-back asphaltic oil" is a Mexican or other natural asphaltic oil which has been reduced or thinned to a working consistency by the addition of light distillate.

All available types of oil in the market have been included in the experiments and the product of any individual refinery will fall into one of the classes of oil under test. To insure fair competition between different oils, each one has insofar as the refiners would supply it been used in equivalent grades, the grading being based on the Specific Viscosity Test at 60 deg. C. and the Solid Residue Test. On the Cambridge Road oils having a Specific Viscosity of as near 21.0 as possible and meeting the Illinois E-3 Specification as to solid residue of 100 penetration were used. On the Rosemond Road oils having a Viscosity at 60 deg. C. of 12.0 and meeting the Illinois E-2 Specification requirements for solid residue were used.

Section 11-C. ¾ gal. per sq. yd. in three applications of cracked pressure tar residue (Oil No. 2-C).

Section 12-C. ¾ gal. per sq. yd. in three applications of cut-back asphalt base oil (Oil No. 5-C).

Section 13-C. ¾ gal. per sq. yd. in

three applications of Mid-continent cracked residuum (Oil No. 4-C).

Section 14-C. ¾ gal. per sq. yd. in three applications of Mexican asphaltic base oil (Oil No. 3-C).

Section 15-C. ¾ gal. per sq. yd. in three applications of Mid-continent skimmed oil (Oil No. 1-C).

Section 11-R. ½ gal. per sq. yd. in two applications of Mid-continent skimmed oil refined from Illinois crude (Oil No. 3-R).

Section 12-R. ½ gal. per sq. yd. in two applications of Mid-continent skimmed oil refined from Arkansas crude (Oil No. 5-R).

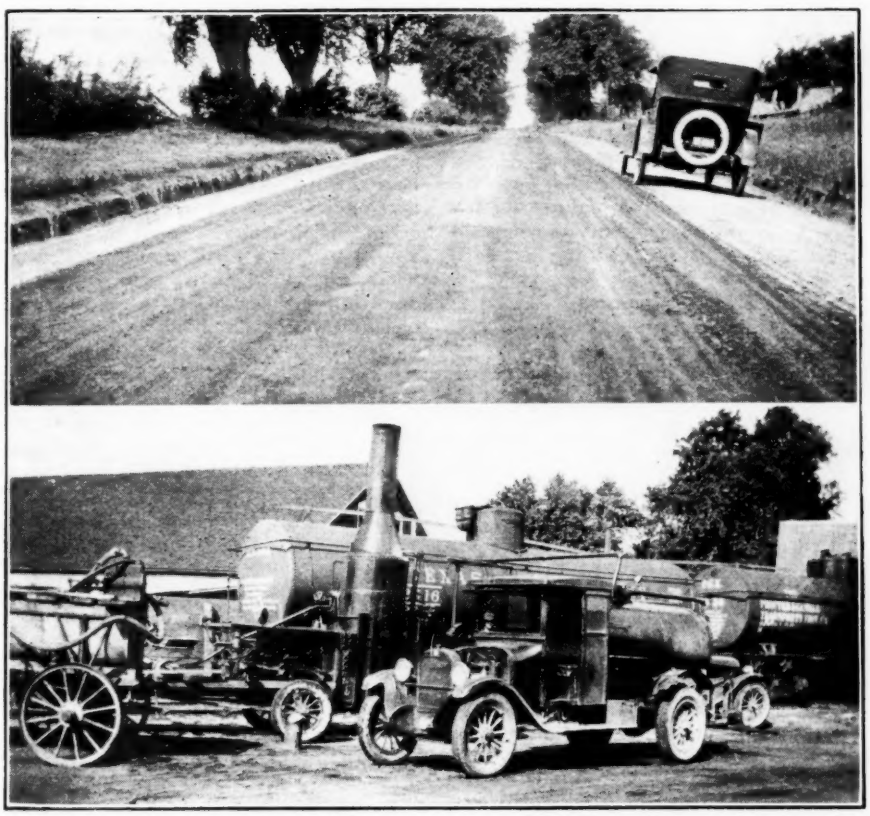
Section 13-R. ½ gal. per sq. yd. in two applications of blended Mid-continent skimmed and Mexican asphaltic base oil (Oil No. 4-R).

Section 14-R. ½ gal. per sq. yd. in two applications of Mid-continent cracked oil refined from Oklahoma crude (Oil No. 6-R).

Note. Observations of cracked pressure tar residue will be made on Section 5-R.

Experiment With Different Grades of Oil

The term "grade" is used here in a different sense than "kind." Any of the kinds or types of oils mentioned in the preceding series of tests might come in a number of grades ranging from light, thin oil for cold application to very thick, heavy products for hot application. In this series of tests only those grades commonly employed on earth roads have been used.



EXPERIMENTAL STUDY OF OILED ROADS IN ILLINOIS—TYPICAL OILED ROAD AND THE OILING EQUIPMENT.

Section 5-C. ¾ gal. per sq. yd. in three applications of light oil showing 55% of solid residue of 100 penetration. Oil No. 6-C used.

Section 3-C. ¾ gal. per sq. yd. in three applications of extra heavy oil showing 72% solid residue of 100 penetration. Oil No. 7-C used.

Section 9-R. ¾ gal. per sq. yd. in three applications of medium grade oil showing 67% solid residue of 100 penetration. Oil No. 2-R used.

Note. Sections 5-C and 3-C are comparable with sections 11-C to 15-C, inclusive, and section 9-R is comparable with section 1-R and with sections 11-R to 14-R, inclusive.

Experiment With Priming Coat of Light Oil Followed by One Application of Heavier Oil

An initial application of light oil has been used in this series of tests followed by an application of heavier oil. The use of the coat of light oil is analogous to the use of the priming coat of thin paint which painters use on new wood surfaces. It is contended by some that the coat of light oil will give depth of penetration and serve to bond the wearing mat to the sub-grade, thus preventing scaling and loosening of the wearing surface which sometimes happens under the influence of frost action.

Section 4-C. One application amounting to ¼ gal. per sq. yd. of light oil followed as soon as absorption was complete by one application of heavier oil. Oil No. 6-C used for priming coat. Oil No. 2-C used for final application.

Section 8-R. One application of ¼ gal. per sq. yd. of E-2 grade oil followed by one application of E-3 grade oil. Oil No. 1-R used for priming coat. Oil No. 2-R used for final application.

Experiment With Varying Widths of Oiled Roadway

While an oiled strip 16 ft. or under is desirable even where traffic is light, many roads in Illinois are oiled in much narrower widths. The following sections have been oiled in less than standard widths to compare with the wider sections.

Section 1-C. Oiled by applying two 8-ft. strips down each side of the road and one 8-ft. strip down the center, thus making an oiled roadway 16 ft. wide with a single application on the outer 4 ft. at each side and two applications down the center. By this method of oiling a 16-ft. oiled roadway is obtained with the same quantity of oil that would be required for a 12-ft. road with two applications the entire width. Oil No. 3-C used.

Section 2-C. Oiled with two applications, 12 ft. wide. Oil No. 3-C used.

Section 10-R. Same treatment as section 2-C except oil No. 2-R used.

Maintenance

Section 15-R. This section shall receive no drag or other maintenance subsequent to oiling.

Section 16-R. This section is under intensive drag maintenance.

Different types of drags and maintainers will be tested out on other sections in an effort to arrive at the most efficient and economical method of maintaining an oiled road.

Traffic Tests

It is evident from ordinary observations that different kinds of traffic exert a markedly different effect on an oiled road. Narrow steel tires seem to cut up and rapidly destroy an oiled surface while on the other hand pneumatic tires exert an ironing effect which is highly beneficial if not essential to the formation of a satisfactory wearing surface. A limited number of traffic tests will be conducted in order that the effect of different kinds of traffic may be studied.

Soil and Drainage Conditions

The sites chosen for the experiments represent average Illinois conditions. At Cambridge the soil consists of brown silt loam with strips of black clay loam in the low places. The same general type of soil occurs at Rosemond but it is less dense and therefore not so gummy and sticky when wet and is more easily ground to dust in dry weather. Both roads are supposedly well drained and are free from deep cuts or excessive grades.

Grading and Preparation of Road for Oiling

Both roads are graded to a width of 24 ft. and carry an average crown of about 9 ins. The Rosemond Road has not previously been oiled but was graded as a state aid improvement in 1916. No grading was required on this road, it being only necessary to prepare the surface for oiling. The road was given careful drag maintenance for about a month before oiling and just prior to spreading the oil was given a final smoothing up, using a heavy, 3-way drag on some of the sections and a small, patrol grader on others. The soil on this road is inclined to be light and silty and easy to work. With very little work the surface was brought into perfect condition for oiling.

The Cambridge Road had been oiled the previous year but had broken up during the winter and spring so that little or no oil was in evidence at the time it was selected for the experiment. This road required considerable reshaping to put it in suitable condition for oiling. Grading was started May 18 and completed May 25, after which the road was kept carefully dragged until final preparation for oiling was begun. The finishing of the surface was accomplished with a 4-sectional blade maintainer with a mould-board drag attached behind. By means of the maintainer, a perfectly

TABLE I—ANALYSIS OF OILS.

Oil Number	Name of Oil	Specific Gravity at 25°C.	Engler Viscosity at 60°C.	Total Bitumen, per cent.	Bitumen insoluble in 86° Be. Naphtha per cent.	Fixed Carbon, per cent.	5 hour Evaporation Loss, per cent.	Flash Point, °C.	Solid Residue of 100 Penetration, per cent.	Ductility of Solid residue
1-C	*	0.939	21.4	99.7	1.4	2.9	....	210	67	1σ
2-C	**	1.041	18.7	99.8	12.4	9.1	....	183	68	100+
3-C	***	0.963	23.5	99.9	15.6	8.0	5.6	105	63	100+
4-C	****	0.948	17.1	99.3	5.6	4.1	....	195	69	2
5-C	*****	0.961	15.6	99.8	14.9	7.5	15.2	98	59	87
6-C	******	0.938	10.3	99.9	6.7	4.3	5.4	95	55	42
7-C	**	1.055	32.6	99.7	17.1	10.9	....	185	72	100+
8-C	******	0.953	21.6	99.8	9.6	6.0	....	133	63	36
1-R	**	1.031	11.3	99.9	12.5	8.7	....	185	63	100+
2-R	**	1.043	22.1	99.9	13.1	8.9	....	195	68	100+
3-R	*	0.938	13.7	99.9	2.9	2.9	....	190	56	11
4-R	******	0.947	10.6	99.9	5.6	4.3	4.5	115	55	21
5-R	*	0.943	13.6	99.9	8.6	5.1	....	129	58	41
6-R	****	0.945	10.3	99.5	6.1	4.0	....	155	62	2.5

* Mid-Continent skimmed oil.
** Cracked pressure tar residue.
*** Mexican asphaltic oil.
**** Mid-Continent cracked oil.
***** Cut-back asphaltic oil.
****** Mid-Continent-Mexican Blend.

smooth surface free from all waviness or unevenness was obtained. The drag served to crush up all traces of clods or sods deposited at the discharge end of the maintainer blade.

Application of Oil

The Cambridge Road was oiled between June 14 and June 20 and the Rosemond Road during the last three days of June. All oil was heated to a temperature between 150 and 160 deg. F. before application. At Rosemond the oil was heated in the tank cars by conducting a jet of live steam directly into the oil through a ¾-in. pipe entering the car through the dome. Laboratory tests revealed that about 3% of water was introduced into the oil by this method of heating. About four hours were required to bring the oil to the required temperature. At Cambridge the oil was heated by means of a patented instantaneous steam heating device as the oil was pumped from the car to the distributor. Practically no water was introduced into the oil by this method of heating.

Pressure distributors of a late type, without heating attachments and equipped with pneumatic tires, were used on both roads. Those used at Cambridge had a capacity of only 460 gals. and were capable of attaining a high speed. This type of distributor has the advantage over the heavier types in that it does less damage to the prepared grade than heavier machines or machines equipped with solid tires. One of the machines used at Rosemond had a capacity of about 600 gals. and the other about 750 gals. The latter machine proved too heavy as it caused some deformations of the prepared road surface.

On both roads the distributors were carefully adjusted to spread at the rate of ¼ gal. per square yard. Each application was allowed to be completely absorbed before applying the succeeding coat. When more than ¼ gal. per yard was applied at one time, it was found that the oil tended to flow to the sides of the road before it was absorbed.

ANALYSIS OF SOME CENTRAL STATION HEATING PLANT PROBLEMS

At the Crookston Convention of the League of Minnesota Municipalities, in 1922, a resolution was passed requesting the analysis of some of the problems of Central Heating in the State of Minnesota. In accordance with this resolution the Executive Secretary, Mr. Morris B. Lambie, requested me early last fall to make a study of this new public utility.

Being an engineer, I was mainly interested in the engineering problems that are met with in this branch of heating but as I could readily see that the League was also interested in the legal problems that centered on Central Heating I made a study of them as they appear in the State of Minnesota.

Legal Aspects in Minnesota

Chapter 122 of the Laws of 1917 as amended by Chapter 108 of the Laws of 1921 gives all cities of the fourth class

(that is to say, cities with 10,000 inhabitants or less) and all villages with less than 10,000 inhabitants the power to own, operate, and acquire central station heating plants. At the present time such a power is denied the cities of the first, second, and third classes. Whether these large cities can experience this power without legislative authority is a question. According to a decision in a Montana court it can be acquired by implication. The learned judge expresses himself somewhat as follows: "A municipal corporation having express authority to operate an electric light and power plant may lawfully, as incident thereto, lay conduits to enable it to supply surplus steam from the plant to heat the houses of its inhabitants." (Milligan vs. Miles City, 51, Montana 374, 153 specific 276, L. A. R. 1916C 395.)

In case of home rule cities in the first, second, and third classes I am of the opinion that this may be done in Minnesota. It is a municipal power that has in some cases been delegated to municipal corporations in Minnesota and elsewhere, and as it is not against the general policy of the State and pertains to a municipal subject there is a possibility that the above mentioned muncipalities may own, operate, or acquire central station plants without special legislative action.

In the case of the other cities without home rule charters and in the first, second, and third classes, it is possible that they might try to own and operate municipal heating plants as a by-product of an electric plant on the basis of the Montana decision cited previously. Whether they would succeed in doing so is a question for the courts to decide. They could not, however, in my opinion, own and operate a plant whose primary purpose was heating, or whose primary purpose was heating with electricity as a by-product without first getting authority from the State legislature. This authority could be given by special statute drawn up for the purpose or by amending Section I of Chapter 452 of the Laws of 1907 so as to include heating plants within the definition of 'public utilities" as defined in that act. As far as I can see there is no good reason for denying this right to the larger municipalities and I suggest that the League, through its many friends in the legislature, take action and see that this power be given all Minnesota municipalities regardless of size or classification.

The engineering problems of central heating are the same in Minnesota as elsewhere and they simmer down to getting heat to the consumer and the condensation back to the power plant at as low a cost and in as efficient a manner as possible. But before presenting a series of facts or figures together with the engineering terms, I believe it wise to present a brief resume of the history and advantages of this utility and also impress you with the fact that none of the problems can be presented in great detail without becoming very monotonous and tiring.

Growth of Central Station Heating

The original district heating plant was installed by the late Birdsall Holly in the small city of Lockport, New York, in 1877, and supplied heat to approximately five stores, seven residences, and two churches, through about one mile of underground piping. Live steam was used and the water of condensation returned to the plant and re-evaporated. Approximately ten years later the first installation of a central station hot water heating plant was begun. Since that time the use of central station heating has become more and more extended until in 1917 there were approximately 401 central station heating plants in the United States that supplied heat on a commercial basis either as a municipally or privately owned plant. Of this total number 351 were steam plants, and 50 hot water. (These figures were obtained by Mr. H. C. Kimbrough, Western Manager for the American District Steam Company.)

The advantages of Central Station Heating are threefold: (1) The advantages to the consumer; (2) The advantages to the community in general; and (3) As a by-product to the plant to which it is connected.

Advantages to Consumer

The advantages to the consumer are: No coal in the basement with coal dust and ashes over the house; no ashes to be hauled; and no smoke to contaminate and stain the curtains and walls. There is always a constant even heat with plenty of hot water for domestic purposes. There are no fires to build and attend, and no worry about freezing of pipes when away from home. Insurance companies are just awakening to the fact that cheaper rates should be given a home supplied with central heating, and this item should not be over looked.

The expense of central heating to the consumer depends upon the individual. There is real opportunity for economy. By a proper use of heat when needed,

the invoice for heating should be a very little larger than for the individual plant. Some companies even claim a reduction in the cost. There is, however, a distinct saving in that there are no boiler repairs, no boiler investment, no ashes to be hauled away, and possibly lower insurance rates. In every case the installation of a central heating plant has increased the value of the consumer's property and in that manner lowered the expense.

The community is benefitted by the installation of central heating plants: (1) By the general increase in the value of the property, and (2) by the abatement of the smoke nuisance.

The Most Advantageous Application

As a by-product to an electric plant central heating finds its most advantageous application. It is a known fact that practically every steam operated power station is, from an economic standpoint, wasteful. A single expansion engine will not use more than about 7 percent of the heat supplied to it; a compounded engine about 11 to 13 percent; and a triple expansion engine about 18 to 20 percent. Hence 80 to 93 percent of the original heat is available for other purposes, and much of this heat can be reclaimed from the exhaust steam by using the latter for heating purposes. When this is done the engines must be run non-condensing and carry sufficient back pressure to cause the steam to circulate.

Contract Provisions

To connect a consumer to a central heating plant is not as easy a matter nor as inexpensive a matter as it may appear. The cost varies depending upon the type of plant used prior to the time of connection and directly as to the distance of the installation from the mains. As a rule the contracts contain provisions somewhat as follows:

"The company agrees to install service pipes for the above named premises to the property line free of charge. From said line, the Company will install the service pipes at the following rates . . . ."

"The consumer agrees to make all necessary changes and additions to his present heating pipes and apparatus on above said premises, that the rules and regulations of the Company may require in order to insure a satisfactory service to the consumer. If at the present time there are no heating pipe and apparatus, but the consumer contemplates installing the same, no service connection shall be made to the consumer's premises until such new installation of heating pipes and apparatus has been approved by the Company."

"It is further agreed that the service pipe and extensions thereof, meter, meter connections, valves, or any other connections installed on the consumer's premises by or at the expense of the Company shall remain the property of the Company and subject to removal by, and only by, said Company.

As practically every Central Heating Plant installation uses either steam or water as heating medium it follows that many individual plants are unsuited for connections.

Premises heated by stoves or hot air furnaces must have new heating apparatus installed. Where hot water radiators are installed, steam or hot water may be used. Where steam radiators are installed only some form of steam will prove satisfactory. It follows from the above that as a rule, a steam installation of some form is the more flexible type of central heating plant to erect. However, as both plants are in use a discussion of the various characteristics will be given to amplify the preceding statement.

There are two types of hot water systems used—the one and the two pipe system. In the first case suitable shunts must be provided so as to allow for proper circulation. The two pipe system operates similarly to the ordinary hot water installation except on a larger scale. The two pipe system is the more common method of design. To maintain a vigorous circulation in either system centrifugal pumps are connected to the return side of the system.

Advantages of Hot Water System

(1) Line losses from heating mains are less than in a steam system. The average temperature of a hot water main is about 160 deg. F. compared to the steam main at 212 deg. F. or more.

(2) Hot water mains are readily adapted to undulating ground conditions. If the service connections are taken off at the high points to relieve the air the mains may follow the contour of the ground. This is not true in the case of a steam installation. Here the steam and return lines must be carefully graded so as to eliminate pockets, and if relayed at any point drips with the attending trap and seal connection must be provided.

(3) The heat supplied is easily controlled by regulation of the hot water temperature according to the variation of the outside temperature. Tables have been prepared giving the variations. The

ordinary rule on which these tables are based is to have the temperature of the circulating water at about 160 deg. F. when the outside temperature is 30 deg. For each degree rise in the outside temperature the circulating water temperature is lowered 1 deg. Some tables take into account the wind velocity.

(4) Either exhaust steam from the engine and pumps, or live steam from the boilers may be used to heat the circulating water. The heating of the water is accomplished by passing it into tubular closed water heaters, or "commingiers" of the injector type, or by passing it through water-heating boilers.

(5) Gives a more pleasant and agreeable heating.

(6) Possible to run engines either condensing or non-condensing.

Advantages of Steam

(1) Generally cheaper to install. Does not require as large a pipe as the water system.

(2) Can be used for long distance distribution.

(3) Can be forced to carry overloads to a far greater degree than a hot water system.

(4) Operates satisfactorily on either steam or water radiation.

(5) Within practical limits, this system is not subject to pressure limitations.

(6) Easy to meter.

In designing a steam plant the engineer has wonderful opportunities for originability and ingenuity in working out his piping and distribution. He may use high pressure or low pressure in his mains, or a combination of both. He may have points of distribution to which he runs mains of high pressure and from which he runs mains of low pressure, or he may branch off from the main directly to the consumer's premises using a reducing valve to obtain a pressure of 1 to 2 lbs.

The design depends upon the locality, the topography, the cost of good water and its supply, and the cost of labor and materials. In any event, the engineer should always bear in mind that the economies and profits vary inversely as the mile of pipe in the distributing system.

A layman reading about the many advantages of central heating will think to himself, "Now why hasn't my town such a plant? We are just as large as the town of X and they have a plant." Then he reads in the newspaper of this heating plant being a failure and this one a success. Both plants are about the same size located in towns of almost the same characteristics. Then he wonders what determines the success of a district heating plant.

Factors Affecting Success

I will try to answer this question to the best of my ability, but the conditions are so complex and so varied and so subject to local conditions that I appreciate that the explanation offered cannot cover all situations. In order to grasp the points more easily they are presented in an outline form and then expounded in a more detailed manner.

(1) Sufficient demand for heat:

(a) Size of town; (b) Number and nature of industries; (c) Number and nature of institutions; (d) Number and nature of mercantile establishments; (e) Number of homes; (f) Characteristics of inhabitants; (g) Competing district heating plants; (h) Character of service and price charged; (j) Climate.

(2) Density of population and industries.

(3) Location of plant relative to the district to be heated.

(4) Location of plant relative to the water and coal supply.

(5) The variability of the engine load.

(6) Design and equipment of the plant.

Sufficient Demand for Heat

The size of the town; number and nature of industries; institutions, and mercantile establishments; and the number of homes are indicative of the possible heat load, while the characteristics of the inhabitants, the competition of other district heating plants, the type of service rendered and price charged, and the climate, will prove to be indicative of the demand for heat. Many a district heating plant promoter has learned this to his sorrow The heat load was available but the orders connecting the same to the system were woefully lacking.

Knowledge of the type and characteristics of the inhabitants is essential to a promoter. Some classes of people are not financially able to pay for the advantages that district heating offers. They will cling to the old method of heating by stoves, or hot air furnaces, because that is the more economical. Religious, racial, and political friction between various functions may spell the down-fall or success of a plant. This is especially true in the smaller towns.

If the inhabitants have the ability to pay for the advantages of district heating, the character of the service rendered, and the rates charged will be controlling fac-

tors in their decision in the question of whether or not to install the same.

The combination of heat, light, and power supplied from a single plant tends to increase the economical operation by increasing the local factor. The labor cost in such a combination is not materially larger than for a single plant and competition is unwarranted, except in case of gross mismanagement which is productive of faulty service and high rates.

Figures have been produced tending to show that district heating is cheaper to the consumer financially than the small individual plant. Such cases are exceptions, however, and the service rendered must be of such nature as to warrant the expenditure of the additional money.

Density of Population and Industries

This is the basic criterion of whether a district heating plant should be installed. If the density of population is small the heat losses during transmission will be large, and likewise the fixed charges. The heat losses vary directly as the miles of pipes.

Location of Plant Relative to the District to Be Heated

There are two distinct items to have in mind when locating a plant in reference to the district to be heated: (1) line losses, (2) pressure to be carried.

As noted before, the line losses increase directly as the miles of pipe and, hence, it is desirable to locate the plant as close to the center of the heating load as possible.

The use of exhaust steam necessitates short distance service so as not to put much back pressure on the engines.

Location of Plant Relative to Water and Coal Supply

The points to be considered under water supply are four in number: Quality, Availability, Purity, and Hardness.

There should be a certainty of water supply because in a district heating plant the water loss may be great. Often the condensation is emptied into the sewer to avoid mechanical difficulties and excessive original cost arising in trying to return the same to the heating plant. Elevators, laundries, etc., also take a large consumption which cannot be returned to the plant.

The availability of the supply is usually easily solved and only in extreme cases viaducts may have to be constructed, but this is exceptional. The purity and hardness of the water are closely related. Alkalinity or acidity may produce excessive corrosion in the pipes, while hardness produces thick incrustations on the boiler tubes, reducing greatly the efficiency and increasing the maintenance cost. The hardness of the water may be removed by water softening processes.

Storage and railroad facilities are the two important items in connection with the coal supply. There must be a possibility for at least 30 days supply of coal. Where the comfort of several hundred people is in question, the district heating plant manager must not take any risk of a shut-down because of the lack of fuel. Even with a 30 day's supply on hand, there will be times when strikes or storms will cause the supply to dwindle to a dangerously small amount.

The plant should be located close to the main railroad line so as to reduce the initial cost and also to take advantage of the smaller amount of track to be kept open during the winter blizzards.

The Variability of the Engine Load

The ideal situation would be to have the load large enough so that each piece of apparatus using steam would be operating at full load most of the time. This will produce larger profits because as a rule exhaust steam will give a larger profit than live steam.

Design and Equipment of the Plant

In this connection the word "Plant" is used in its broadest meaning, including not only the boilers and their auxiliary equipment but also the mains, fittings, valves, conduit, and covering.

In laying underground conduit the materials and workmanship must be of the best. Inspection is difficult and repairs expensive.

The piping is usually carried in tunnels or conduits placed preferably below the frost lines. Conduits are cheaper and this is the common method employed. These vary in cost, form, and construction. Wood boxes, wood stave casing, concrete casing, and split tile are extensively used.

The tile must be laid in a trench that is properly drained. In sandy soil this is easily done but in clayey soil the tile must be laid on a cushion of crushed stone or rock.

The pipe covering must be of some efficient material. Wool felt, asbestos, mineral wool, kieselguhr, and magnesia are the most common materials used. The fittings as well as the pipe should be well covered. The thickness will depend upon the plant lay-out and simply becomes a matter of calculating the benefits derived against the cost of the installation.

In selecting a pipe covering not only

the insulating properties and the cost of covering should be considered, but also several physical characteristics.

The covering should be easy to apply and should be of a material whose tenacity of structure will prevent easy breakage and whose chemical composition is such, that in case of becoming wet it will regain its insulating properties when dried out.

To operate a central heating plant successfully accurate records of cost and performance are necessary, and to accomplish this purpose a complete set of steam, water, and draft gauges, and meters is essential. In selecting the meters to measure the condensate at each service connection special care should be exercised. Accuracy, ease of installation and reading, compactness, absence of wearable parts, lightness, and cost should all come into consideration when selecting these meters.

Data on iMnnesota Plants

At the present time there are approximately 30 central heating plants, omitting all institutional central heating plants such as the one at the University of Minnesota, in Minnesota, having a connected amount of radiation of about 2,500,00 sq. ft. Of this number there is only one plant that uses water as a circulating medium entirely, and one plant that uses both water and steam, while the rest use steam entirely. Some idea of the adaptability of central station heating may be gained when it is noticed that the connected amount of radiation varies from 2,600 sq. ft. at one plant to approximately 800,000 sq. ft. at another.

One characteristic of central station heating in Minnesota is noted in that there are only seven privately owned plants—the rest being municipally owned.

Of the total number of stations over one-half use the vacuum system of heating, either entirely, or in connection with some other method, and only three plants do not use exhaust steam as a portion of their source. The pressure carried in the heating mains varies from 10 in. vacuum to 150 lbs. pressure. The most common pressure in the mains is approximately from 3 to 5 lbs. The pressure in the services from 10-in. vacuum to about 8 lbs. pressure.

In regard to the cost of installing central heating. It is here that an official will make a greivous error if he is not careful. He will be told that this town had its installation completed at a cost of $9 per running foot of main and cannot understand why the installation in his town should be $11 per running foot under what appears to be practically the same conditions. The towns are the same size; the connected load almost equal to the square foot of radiation; the industrial and retail districts similar; and yet this central heating company wants about $2 more per running foot of main than in the town of X.

What this official does not know is that the soil in his town is clayey, necessitating more feet of drains than in the town of X where the soil is sandy; that due to crowded conditions in his streets by gas, water, and sewer mains, expensive offsets were necessary at practically every corner; that expansion joints or variators were placed slightly closer together; that additional one quarter inch thickness of pipe covering had been installed; and that the pipe sizes were large enough to take care of a normal expansion of services for several years to come. As time goes by this official will realize that perhaps the additional cost was justified when he sees what is happening to his neighboring town. Additional services have made the mains too small and they are being dug up and replaced and this costs money.

Competition will usually see that the minimum sizes of pipes and the smallest wall of pipe covering are used but it is up to the officials to see by careful attention to engineers' opinions that the installation is properly designed.

Central heating companies are as a rule as vitally interested as the public in the success of a plant. It means more business for them. Do not subject their corps of expert engineers to such cutthroat competition that the only recourse that they have left is to design a system that is large enough today and too small tomorrow. Conditions vary greatly in every municipality and comparison should not be by a layman who cannot see exactly why one installation costs more than another. He should bear in mind that every condition that I mentioned as affecting the location of the plant will also affect the cost of the plant and he should also remember that operating costs are as big an item as the original cost.

In conclusion I have one or two recommendations to make to the League. The first is to prepare a model franchise for use in central station heating provided you have not already done so. Second, to make a detailed study of the comparative advantages of hot water and

steam heating mediums. Third, to make a study of the best method of financing the installation of municipally owned central station heating plants and the rates to be charged.

The foregoing is an address by Mr. Lund before the Annual Convention of the League of Minnesota Municipalities at Faribault, June 21, 1923.

ORNAMENTAL MEMORIAL HIGHWAY BRIDGE OVER WISCONSIN RIVER AT SAUK CITY, WIS.

By W. C. Buetow, Bridge Engineer, Wisconsin Highway Commission, Capitol Annex, Madison, Wis.

The completion of the Wisconsin River bridge at Sauk City, established a new precedent in bridge ornamentation for Wisconsin. This was due to the generosity of two citizens of Milwaukee, Wisconsin; namely, Ex-Governor Emanuel Phillip and Architect A. C. Clas. These two distinguished men who were reared in Sauk City make it possible for that city to have the beautiful approach. Ex-Governor Phillip paid for memorial approach and Mr. Clas designed and supervised the installation. The approach is shown herewith.

Sauk City lies 25 miles northwest of Madison on State Trunk Highway 12, which is the most direct route from Chicago to the Twin Cities. It passes through the famous Lake Geneva district, Madison, the capital city of Wisconsin and touches the Dells of the Wisconsin River at Kilbourn. Between here and the Twin Cities the road passes through many points of interest.

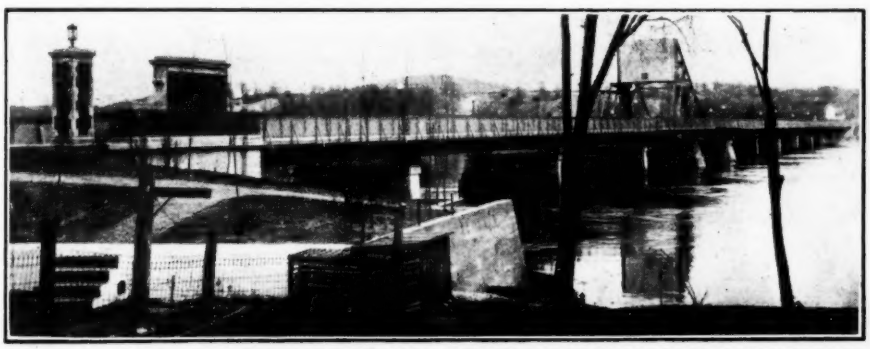
Wisconsin Special Bridge Act

The state legislature in 1919 and 1921 enacted a special bridge act for the purpose of enabling communities to construct large bridges. Structures like the Sauk City bridge would be too big a burden for rural districts if it were not for the special state aid. The 1923 legislature increased the appropriation from $100,000 annually to $125,000 for 1924, $150,000 for 1925 and thereafter $175,000.

Briefly, the following are the general provisions: Any city, village or town bordering upon or through which any navigable or meandered stream runs is authorized or empowered to build a large bridge either alone or jointly. To be eligible, the bridge must be 450 ft. in length exclusive of the approaches. When formal application has been made for aid the State Highway Commission must hold a hearing and submit its findings. They have the power to decide the necessity for a bridge, the location and the type of structure. If deemed necessary the commission notifies the units of government involved of the amount of money they must raise. The city, village or town must then raise one-third the cost and it is obligatory on the county to provide its one-third, and the state the balance. The entire work is under the supervision of the Wisconsin Highway Commission.

Bridges of 300 ft. or more in length lying on the State Trunk Highway or on a road or street in a city of the fourth class forming a direct connection of the State Trunk Highway system is eligible to state aid. Under this provision the state pays 50% and the county 50%. They, however, have a right to assess the city or town which is directly benefited not more than 40% of the county's share. This work is also under the direct supervision of the Highway Commission.

In order that backward communities cannot hold up important links in the State Trunk Highway system the Commission may institute proceedings and build structures under the preceding provisions.



VIEW OF SAUK CITY, WIS., MEMORIAL BRIDGE OVER THE WISCONSIN RIVER.

VIEW OF WEST APPROACH OF SAUK CITY, WIS., MEMORIAL BRIDGE.

The Sauk City bridge work was let on Oct. 7, 1921, and opened to traffic on Sept 29, 1922. Very good progress was made on the substructure during the winter months. Weather and water conditions were very favorable.

Work started on Nov. 1, 1921. A large stiff leg derrick was placed at the east abutment excavating and driving piles. A similar derrick but smaller was started at the same time from the west bank driving falsework trestle. On December 12th the trestle was completed and the east abutment foundation ready, for pouring. Concrete was placed on December 16th. Due to bad weather and the holidays the abutment was not finished until Jan. 10, 1922. From this date to March 13th eleven piers were comp'eted, containing 2,093 cu. yds. of concrete and 10,000 lin. ft. of piling.

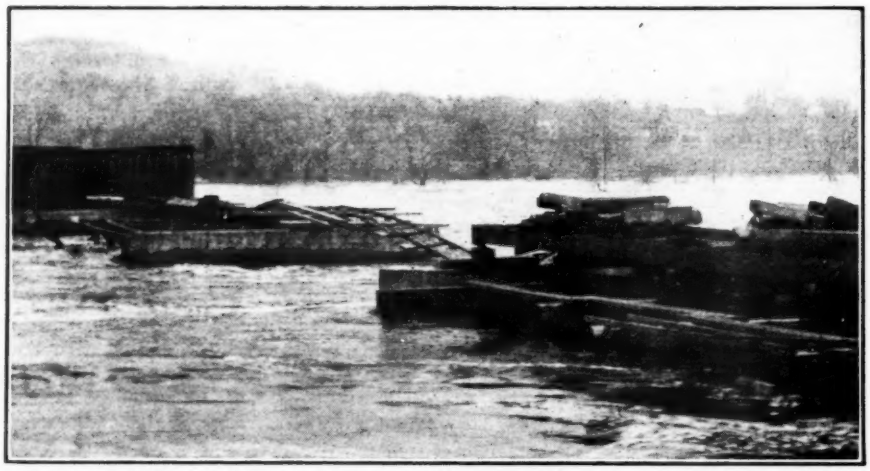
Construction Difficulties

On the 10th of March the river started to rise and by the 14th all work on the foundation stopped until the 29th of May. An accompanying view shows the high water stage. Normal water is approximately 12 ft. below that shown in the pictures.

Some steel stringers, industrial track and two spans of falsework were lost. During the high water the river bottom was washed from beneath some of the piers for a depth of 8 ft. The entire load was carried on the 30 ft. piling. As the water receded the sand filled in under the piers. All piers have been rip-rapped up to normal water elevation. No doubt this will be lowered somewhat next spring during high water.

Cold Weather Concreting

All concrete in pier footing was placed by a tremie. Steam was run in the water in the cofferdam for 24 hours before any concrete was deposited. After the footing was poured the pier was completely housed in with canvass. Forms were then built and steam coils placed outside the neat work from just above the footings. The aggregates and mixing water were heated. During the placing of con-



HIGH WATER STAGE DURING CONSTRUCTION OF SAUK CITY, WIS., BRIDGE. SOME STEEL STRINGERS, INDUSTRIAL TRACK AND TWO SPANS OF FALSEWORK WERE LOST.

crete for three days after completion steam was kept up.

The contractor produced his coarse aggregate from a gravel pit on the east bank of the river. Good sand was found in a bar. The mixer was located on the east bank and the concrete was transported by industrial railway. The concrete for the floor and sidewalk was made from shipped-in aggregates.

Quantities

The structure consists of ten 84-ft. plate girder spans, an 80-ft. Schurzer Rolling lift and its 70-ft. approach girder. There is a 6-ft. sidewalk on the down stream side and the structure has a 19-ft. clear roadway between curbs.

Three thousand cubic yards of concrete were poured, 13,270 lin. ft. of piling driven and 1,281,120 lbs. of steel placed. The substructure is protected by 2,200 cu. yds. of rip-rap.

Considerable grading was required in the east approach which was on a new location; 27,000 cu. yds. of fill was placed and 5,512 sq. yds, of one coarse concrete paving laid.

Cost

The structure proper, including $1,500 for wiring and lighting fixtures cost $148,531.76. The approach cost, exclusive of the memorial work, was $31,050 55, or making a total expenditure of $179.582 21. Right-of-way on the two approaches, engineering and supervision brought the total to approximately $190,000.

THE O'SHAUGHNESSY DAM AND ITS DEDICATION

(Editor's Note: It is often said that the work of the engineer is not understood and appreciated by the public. Generally speaking, this is true. A few monumental structures bear the names of their builders and that is the case with the O'Shaughnessy Dam of the great Hetch Hetchy project in California. The present article describes the dam and its construction in detail and also tells of its formal dedication. It is a distinct pleasure to record here this evidence of popular and official appreciation of the work of one great engineer. The matter here presented is all taken from the July 19, 1923, number of the Municipal Record, the official journal of the City and County of San Francisco, which was entirely devoted to this subject.)

Naming the Dam

Resolution No. 20950, adopted unanimously by the Board of Supervisors on March 26, 1923, by the Board of Supervisors of the City and County of San Francisco, naming the dam, reads as follows:

"Whereas, the dam at the outlet of Hetch Hetchy Valley has been completed, which will convert this valley into a mammoth reservoir, impounding for the use and benefit of future generations billions of gallons of water that heretofore have gone wastefully to the sea; and

"Whereas, the dam is one of the largest structures of its kind in the world and long will endure as evidence of the knowledge and genius of its creator, the Honorable M. M. O'Shaughnessy, City Engineer of the City and County of San Francisco; therefore,

"Resolved, That as a monument of the great ability displayed in its creation, and to perpetuate in the years to come the name of its builder, said structure shall be designated and hereafter be known as 'O'Shaughnessy Dam,'; also

"Resolved, That the Board of Public Works be directed to have the aforesaid name suitably engraved upon the structure."

The Dedication

Terminating the labors of 8 years, interrupted by the World War, the O'Shaughnessy Dam, named in honor of its builder, City Engineer M. M. O'Shaughnessy of San Francisco, was dedicated by Mayor James Rolph, Jr., and a group of distinguished citizens gathered at the dam site, on July 7, 1923.

The dedication of O'Shaughnessy Dam marked an epoch in the history of San Francisco. The dam, 341 ft. from foundation to crest, is the first large unit of the entire Hetch Hetchy project to reach completion and it will form the keystone of the stupendous project which will eventually supply San Francisco with water and power sufficient to care for millions. The O'Shaughnessy Dam is one of the largest dam structures in the world and the reservoir it forms is the largest reservoir west of Chicago.

Several Hundred Present

Several hundred citizens, coming from San Francisco aboard a special train and entering the Hetch Hetchy district from Yosemite Valley, participated in the dedication. Heading the San Francisco delegation was Mayor James Rolph, Jr., with City Engineer O'Shaughnessy, while the

Yosemite Valley visitors were led by Former Mayor and Senator James D. Phelan. Representatives of the Turlock-Modesto Irrigation District were also present to participate in the dedicatory exercises.

The keynote of the addresses made by the various speakers was the tribute paid to Engineer M. M. O'Shaughnessy in constructing the dam. Tribute was also given the memory of the late Dr. Edward Robeson Taylor, former mayor of San Francisco.

The program of dedication included the official turning over of the dam to the City and County of San Francisco by the Utah Construction Company, contractors. This company constructed the dam under the direction of Chief Engineer O'Shaughnessy.

The cost of the dam is placed at $6,647,356.34 and required an actual working time of 3½ years, much difficulty being encountered in finding suitable foundation for the structure. The reservoir that it forms is 7½ miles long and in some places ½ mile wide, covering 1,500 acres. The reservoir has a storage capacity of 66 billion gallons, draining a watershed of more than 300,000 acres.

From the bottom of the foundation to the crest of the dam is 341 ft., while the length of the crest is 600 ft. The initial crest elevation is 3,726 ft.

From this huge reservoir, San Francisco will get its future water supply and eventually develop sufficient electrical energy to furnish the city's industries with hydro-electric power.

The Contractor Remembered, Too

On the afternoon of July 7 the group of citizens who made the trip to the dam site aboard a special train from San Francisco, and others who came into the Hetch Hetchy district from Yosemite Valley, assembled before the cottage of Chief O'Shaughnessy. Here, seated in the shade of the trees clustered about the cottage, they listened to addresses which marked a huge step forward in the development of San Francisco. On the bluff above the dam within stone's throw of the structure, tribute was paid to Engineer O'Shaughnessy and the corps of men who made the dam possible.

Promptly at 2:30 o'clock, W. H. Wattis, president of the Utah Construction Company, officially delivered the dam to San Francisco. Wattis recalled the history of the work done on the project and complimented San Francisco on having stuck to the task of its construction.

Congratulations were extended the company by President Timothy A. Reardon of the Board of Public Works, who accepted the dam in the name of the City and County of San Francisco. The work on the dam was under the supervision of the Board of Public Works.

Mayor Rolph's Address

Following the address of Reardon, Mayor James Rolph, Jr., introduced by Chairman J. Emmet Hayden, Supervisor, gave a vivid address, in which he praised the efforts and achievements of Engineer O'Shaughnessy.

The Mayor spoke, in part, as follows:

"The people of San Francisco pay tribute of admiration and respect to M. M. O'Shaughnessy, City Engineer, as we dedicate O'Shaughnessy Dam—the master work of a great career, destined to stand throughout the centuries as one of the mightiest structures built by man. A great knowledge and a wide experience, the genius to create, an inspired vision of the California of the future, and a courage undaunted by the sheer magnitude of the undertaking, have enabled Chief O'Shaughnessy to carry on this public enterprise, fraught with beneficence for the people of our own City and of our broad coastal empire.

"Our Chief Engineer is more than a scientist and a builder. He has the lovable qualities of kindness and unselfishness. He is one of the great souls of our generation. O'Shaughnessy Dam is a monument to his genius. It serves its useful purpose now and will endure for all time. But we who know the builder think both of the work and the man, and while we dedicate the one we salute the other, offering our gratitude and affectionate regard.

"It became my task on assuming the office of Mayor to find a man who could do the job and that man was Michael Maurice O'Shaughnessy. His name will live as long as time, for this great dam is built to stand for 2,000 years or more.

"I am going to read a telegram which I received this morning from a San Franciscan who offers what I consider a splendid suggestion:

"'As a testimonial to the genius and self-sacrifice of M. M. O'Shaughnessy, I offer the suggestion that a fund of $100,000 or more be gathered by popular subscription and presented to him as a

testimonial of appreciation from a grateful people.

(Signed) HARTLAND LAW.'"

The telegram was received with applause and cheers.

"A lot of men spend all their time in the acquirement of riches and affluence, but these riches and affluence leave no monument to the individual. Here is a man, Michael M. O'Shaughnessy, who had no thought of riches and affluence. He has dedicated his life and his work to the community which he loved. When the men who have spent their time acquiring riches have gone on, they leave no monument to their memory, but when M. M. O'Shaughnessy passes to his eternal reward, this monument shall stand to his memory for 2,000 years to come. Many generations shall look upon it and bless this man who gave his genius and life to our City."

Mayor Rolph closed with a tribute to Former Mayor and Senator James D. Phelan, referring to Phelan as the "Father of Hetch Hetchy."

Ex-Senator Phelan's Address

In an address following Mayor Rolph, ex-Senator Phelan reviewed the history of the Hetch Hetchy project from its inception. Ex-Senator Phelan's address, in part, was as follows:

"I have been spending a few weeks in the high Sierra region and, on account of my early association with this work, I could not resist coming here today. Mayor Rolph has generously, in his speech, called me the 'Father of Hetch Hetchy.' I came to the mountains seeking a renewal of youth, and lo! I have been placed in the category of ancestors. But I desire to share the honors of paternity with others better deserving. Under the new charter the city government was directed in 1900 to investigate the sources of and provide for the City and County a municipal water supply, and, with that purpose in view, when elected Mayor, I appointed eminent civil engineers to compose the Board of Public Works. They were Col. George H. Mendell, U. S. A., retired; Marsden Manson and Jeremiah Mohony, contractor and builder, who, in turn, appointed C. E. Grunsky City Engineer. These men knew, after investigation, that there was one site in the mountains to be preferred above all others, available and adequate for municipal water supply purposes, and that was Hetch Hetchy Valley and Lake Eleanor. They jealously guarded their information, which they brought to me and, on their advice, I secretly filed upon the lands in my own name, subsequently turning my rights over to the City. Secrecy was desirable to avoid the interference of rival claimants, speculative locators and cormorant corporations, and I acted as an individual under legal advice because there was a question as to the right of a municipality, as such, to make a filing under the statute.

Fought by Nature Lovers

"Application was then made to the Interior Department for a reservoir right of way, and the long fight was thus inaugurated. The 'nature lovers,' well organized, denounced the proponents of this plan as vandals, and the City of San Francisco as a purblind Philistine seeking to destroy the beauties of nature. It is safe to say that every paper in the United States was in opposition, and every selfish interest, which deprecates public ownership, was arrayed against the City. Secretary of the Interior E. A. Hitchcock, in the Roosevelt Cabinet, decided that the Department had no jurisdiction. On review he reaffirmed his decision; and here I desire to pay a tribute to the well-beloved Theodore Roosevelt, who was our steadfast friend from the beginning. No man loved nature more ardently, but no unbalanced sentimentalist could turn him from his desire to confer a benefit upon a million human beings living by the principal port of the United States on the Pacific, and free them from corporation dictation; while, at the same time, by the conversion of a meadow into a lake, enhance the scenic values of the Sierras.

"In this crisis Theodore Roosevelt referred the legal question to another member of his Cabinet, because, as the President said, 'He is a Californian,' and nothing discouraged by his concurrence in the opinion of Secretary Hitchcock, admitted that he had made a serious error by not, as a matter of course, referring it to his Attorney-General. The Attorney-General decided that the Department of the Interior had jurisdiction, and Theodore Roosevelt rejoiced with the people of San Francisco, who were granted the rights petitioned for by Secretary Hitchcock's successor, James A. Garfield.

Flays "Willful Betrayal"

"Then President Taft's administration followed, and the notorious Secretary of the Interior, Ballinger, was installed in office and, although he had promised me,

on the presentation of a letter of introduction from the retiring President, that he would not disturb any act of his predecessor, he soon gave notice to the City to show cause why the rights should not be revoked. He was presently relieved from office, and, just at the close of the Taft administration, Secretary Walter Fisher heard the City's case, and he recommended that application be made to Congress. The tide of opposition was growing. Robert Underwood Johnson, editor of the Century Magazine, led the fray until, during the hearing before Fisher, after having pronounced a eulogy on the beauty of Hetch Hetchy Valley, he was forced to admit on the stand that he had never seen it. The corrupt city government then delivered a body blow by declaring, through its Board of Supervisors, that the Hetch Hetchy was an inferior site and that they formally abandoned it in favor of the Blue Lakes, which somebody had for sale. The Hammond and Hammond Hall interests filed rights for which the City was obliged to pay a million dollars, as a price of recovery of its own property, lost by willful betrayal.

"The Woodrow Wilson administration succeeded, with Franklin K. Lane as Secretary of the Interior, who, however, was disqualified from acting because he had been San Francisco's City Attorney. But his services were invaluable in advising Congress, and, after several years of persistent campaigning, both Houses finally voted the Raker and Pittman bill giving the City all she claimed as necessary for the development of water and hydro-electric energy. Delegations headed by Mayor Rolph, consisting of Chief O'Shaughnessy, City Attorney Long, Clerk of the Board of Supervisors John S. Dunnigan, Raymond Baker and many others, managed, one way or another, to interview separately each member of both Houses, to impart information and to promote the measure. After holding the bill nearly ten days, President Wilson affixed his signature, and George Harvey, who liked him not, declared in the North American Review that it was a most courageous act, for which he gave due praise to the President because, said Harvey, it was opposed by the entire press of the United States. But Harvey also said that so great was the opposition that he made a personal investigation, and declared that the President could not have justly done anything else.

Ends Long Conflict

"Now, after 22 years of conflict and construction, the O'Shaughnessy Dam, holding back the waters tributary to Hetch Hetchy, is an established fact. It is the work of a great engineer, and no scandal has tarnished the enterprise. It has, indeed, made the mountains more beautiful and its foes are now friends."

Chairman Hayden then called upon Engineer O'Shaughnessy to respond to the oratorical tributes paid him by the previous speakers. After opening his address, Engineer O'Shaughnessy called forward those men who had assisted him in the work of directing the dam construction.

Engineer O'Shaughnessy's address, in which he reviewed the work completed and the obstacles overcome, was as follows:

O'Shaughnessy's Speech

"We are all glad to be here today to participate in the pleasure of dedicating this great structure, which is 341 ft. in height from the bottom of the foundation to the present crest. One hundred and fourteen feet of the foundation work is submerged at the present time with water on the downstream side.

"To accomplish this work it was necessary to build four auxiliary dams, one on the upstream side to divert the main river into the tunnel; one on the downstream side 1,000 ft. below to stop flood water from backing into the excavation, and as the excavation progressed it was necessary to build two auxiliary slender dams, one immediately above the excavation and one below, before the pouring of concrete was undertaken in the main foundation.

"Peaks of floods in these high mountain regions come every year from melting snows on the 10th of June. At no time did the floods damage the foundations. They did, however, interfere with contractors' operations in bringing sand and materials from three miles up the valley.

"A camp to house 250 men was on the floor of the valley half a mile above the dam, as well as the remains of the existing camp which you see. As many as 500 men were employed on the project at one time, and a great many lives were lost through accidents incidental to this dangerous work.

Data on the Dam

The whole floor of the valley was entirely cleared of timber in two operations,

the first in 1915, when all the lower portion of the valley was cleared of timber, and the second in 1921-22, when the remainder of the reservoir basin was cleared.

"The present dam, built in the shape of an arch, with a 700-ft. radius, at the bottom of the foundation is at elevation 3,386. The bottom valve elevation is 3,508; initial crest elevation, 3,726; length of crest, 600 ft.; storage capacity, 66 billion gallons; drainage area, 294,000 acres; reservoir area, 1,500 acres; total concrete volume, 398,967 cu. yds.; excavation, 207,992 cu. yds.

The material from the excavation was hauled by train and deposited for a half mile up the valley. The weight of metal work in the valve system is 2,155,507 lbs., or over 1,000 tons.

"The entire contract estimate of the Utah Construction Company is $6,114,-648.86. The contract price for valves made in San Francisco, Philadelphia and Boston is $532,707.48, which makes a total of $6,647,356.34.

Comparison Shows Advantages

"The Ashokan reservoir of the City of New York, practically double the capacity of the Hetch Hetchy, has cost $32,000,000, which, reduced proportionately, would make a cost of $16,000,000 for the same volume as Hetch Hetchy. The Ashokan, however, is low level, with no power potentialities, so it is my thought that Hetch Hetchy will be very much appreciated by our future inhabitants of San Francisco, who have been struggling for 50 years to obtain a municipal water supply.

"An estimate was made of $4,500,000 for the completion of this project in 1910. Those of you who are familiar with the construction business are aware that the dollar of today will buy as much as the 50 cents of 1910. Common labor has increased in price from $2.50 per day up to $4.50 per day. Other labor has risen in similar proportion. Materials have also advanced. Cement, steel and all other materials have advanced at least 50 per cent beyond the 1910 prices. The powder which I purchased before 1910 for about 6 cts. a pound is now very nearly 20 cts. a pound. Hence, no explanation or apology is offered for the fact that as much cannot be completed now with the same money as in the period of 1910, when this hasty estimate was made.

"Another feature must be borne in mind that the project has been advanced from the 60 million to 150 million gals. a day water supply project to one of 400 million gals. per day, and all our plans have been laid to carry through the project of greater magnitude.

West's Largest Reservoir

"The construction of a dam of this magnitude and the occupation of this valley for a reservoir were forced on the City of San Francisco by interests antagonistic to human welfare. Practically $300,000 was spent between 1910 and 1912 preparing engineering reports on all streams in California from Mount Shasta to Merced to defend the City's rights, which were about to be abrogated to the use of this valley. The bill has been high but the prize is worth the cost. San Francisco has today the largest reservoir of any city west of Chicago. More water is held in this one reservoir than in the combined reservoirs of Los Angeles and San Diego. The work has been honestly done by the Utah Construction Company.

"I feel extremely flattered by the very touching remarks made by Mayor Rolph in relating my association with this work. It would not be fair, however, without distributing the credit for the successful completion of this project to the different other men and assistants who have been associated with its success. With your permission I will introduce Mr. W. H. Wattis, managing director of the Utah Construction Company; Mr. Hank Lawlor, superintendent of the Utah Construction Company, and Mr. A. E. Paddock, the active superintendent and engineer in charge of construction. The City's forces have been ably represented by Mr. L. T. McAfee, who supervised the excavation from 1919 to 1920. He also had charge of the construction of the Twin Peaks tunnel and Stockton Street tunnel in San Francisco. Mr. C. R. Rankin, who was resident engineer during the pouring of all the concrete and the placing of the gate valves, is the senior engineer and employe on the Hetch Hetchy project, having been with us since April, 1914, when the first survey was made into the dam site, and is now going to have charge of the construction of the pipe from Irvington across the Bay at Dumbarton to Pulgas tunnel.

"Mr. Nelson A. Eckart, my principal assistant, who was in active charge of all the Hetch Hetchy project from the mountains to the sea and whose previous experience in completing the Municipal Railways in San Francisco is known to you all. The design for the structure of the dam is due to Mr. R. P. McIntosh,

who is the principal designing engineer on the Hetch Hetchy project and who has been associated with me for over twelve years in engineering work. Mr. R. J. Wood has been associated with Mr. McIntosh in the design of all the engineering plans and to Messrs. McIntosh and Wood I feel very much indebted.

Will Carry On Work

"The foundation has been put in by this generation, which will enable the dam to be carried in the future to a height 85 ft. greater, and which will increase its storage capacity about 50 per cent. This acts as a declaration of a definite policy on the part of the City of San Francisco to carry on and build in the future at a later date a very much higher dam.

"Mr. Davis, late chief engineer of the United States Reclamation Service, thought it should be carried still higher, but that is a problem we shall have to defer for a few years until more pressing needs are solved.

"At a point twelve miles lower downstream, at Early Intake, has been built the main aqueduct, practically 20 miles in length, between Early Intake and Moccasin Creek. All but 4,000 ft. of tunnel has been excavated on this work. It is programmed to have it finished, lined with concrete 16 months from date, when the power house will be all equipped, ready for service, and we shall have another celebration. This will develop about 300,000,000 kilowatt hours. There is a total now of 370,000 used in San Francisco and the great problem of the coming year will be to arrange a safe and sane handling of this enormous power crop. Practically 70,000,000 kilowatt hours furnish the City's immediate needs for street lighting and driving the municipal railways. The great question of the future is what to do with the other units of power to be developed and it will need all the statesmanship in San Francisco to sit down and help solve in a safe and sane manner this problem. There are possibilities for developing over a billion kilowatt hours of power still on this project, one by building a tunnel from Hetch Hetchy to Early Intake and putting in a power house at that point, which will develop possibly 80,000 hydro horsepower, another by building a high line canal from Eleanor to above Early Intake which will develop 40,000 horsepower. Other possibilities for power may be developed on the higher Cherry and other reaches of the City's watershed.

Stupendous Task Ahead

"The great present problem is to get a market for our existing power units, so that it will bring in a revenue and help to pay interest on the bonded indebtedness, and, secondly, to provide money to complete the aqueduct between the Moccasin Creek power house and Irvington. This will have practically 49 miles of tunnels and 45 miles of pressure pipe across the San Joaquin Valley, the cost of which will be practically $30,000,000. The rights of way are now being acquired for this pipe and pole line for a width of 110 ft. across the valley. Tunneling will be less difficult than the Sierra tunnel just completed, where enormous volumes of water were disclosed in shafts and made operations very difficult.

"The Bay Division of the project between Irvington and Crystal Springs reservoir, about 22 miles in length, is in a very forward condition. The Pulgas tunnel, through the Coast Range of hills, 8,700 ft. long, will be bored through inside of two months, and contract has been let for 21 miles of steel pressure pipe by which water from Calaveras and Niles Canyon can be brought across the bay at Dumbarton and placed in Crystal Springs reservoir.

"In obtaining our grants the government made a mandate that the City should develop power. Development of power in small units is not economically justifiable, so we can stand on the wisdom of the policy of developing an initial large power unit, even if it does promote controversy and discussion in the disposal of the product. There were many difficulties and controversies involved in undertaking the construction of this project.

Built Despite Critics

"The thought was suggested that we had no foundation for a dam of any kind. Others suggested that we move down the canyon half a mile. Many others suggested we use motor trucks instead of steam cars for handling our plant and equipment, and many others threw rocks through the plate glass windows for the pleasure of hearing the cracking glass, but in spite of all the critics this work has been carried to a final achievement.

"Our relations with the farmers of Turlock and Modesto have become most friendly and harmonious. They have built a large dam holding over 270,000 acre feet of water at Don Pedro. This makes

a lake that extends back as far as Jacksonville. Before this lake was filled we built a siphon conduit 9 ft. 6 ins. in diameter under the lake for our aqueduct to San Francisco. Part of our railway had to be elevated and changed across Six Bit Gulch, which was paid for by the Irrigation Districts of Turlock and Modesto, so that altogether our relations have been most friendly.

"The Department of the Interior and Department of Agriculture acknowledged the filing of all our maps and our relations with each of those departments have been very harmonious.

"Finally, my hope is that the future people of San Francisco will treasure it and guard it as one of their greatest inheritances."

Former Mayor P. H. McCarthy followed Mr. O'Shaughnessy, eulogizing the chief engineer and his staff of assistants, and paying tribute to Mayor James Rolph, Jr.

Placing of the plaque bearing the inscription, "O'Shaughnessy Dam," on a fountain on the dam was attended by a simple ceremony at which congratulations were extended to the Chief Engineer. Motion pictures of the scene were taken by the official cameraman of the Engineer's Department.

Visitors inspected all parts of the dam, descending several hundred feet into its depths and operating the valves through which million of gallons of water poured each minute.

At the time of the dedication, the reservoir was at its peak and the eighteen siphons were jetting forth hugh streams, which tumbled down the side of the dam in a great white sheet. The noise of the roaring siphons prevented the dedication ceremonies being held on the dam.

Has Natural Beauty

The O'Shaughnessy Dam and the Hetch Hetchy reservoir stand as a refutation to so-called "Nature lovers," who opposed its construction. Here, spreading for seven miles up the valley, lies a placid lake which is destined to become a magnet to all real nature lovers. Caught between two mountains and trapped by the barrier of stone and steel, it is a sight that would warm the hearts of those who delight in natural beauty. In the distance two waterfalls, like two immaculate ribbons, streak down the side of the canyon and are reflected in the huge man-made mirror. None has more accurately expressed the scene than the caption writer of a San Francisco newspaper, who placed the words over a photograph of the dam and reservoir: "Where Beauty and Utility Wedded."

Down the canyon, racing toward San Francisco, the water rushes for twelve miles through a stream as primitive as the day on which it was created. The river in many places is inaccessible, due to the steepness of the canyon. From the Early Intake diversion dam and portal the water will be transported in pipes and through tunnels for 156 miles to San Francisco. The total distance from the O'Shaughnessy Dam to San Francisco is 168 miles. En route this water will be diverted through power houses to develop electrical energy for the operation of municipal projects and sale to industries.

The flow of the water through the dam is regulated by twelve balanced needle valves. Six of these, which are 3 ft. in diameter, regulate the flow to San Francisco, and others, which are 5 ft. in diameter, control the flow which goes to the Turlock and Modesto Irrigation Districts, lower down the Tuolumne. The siphon spillway carries 15,000 cu. ft. per second.

The dam is constructed to allow for expansion and contraction, due to temperature changes. It is divided into blocks, separated by copper strips, where slight movement can take place.

Some Obstacles Overcome on Construction

The primitive nature of the surroundings in the Hetch Hetchy district and at the site of the dam was one of the many obstacles overcome in the construction of the dam. In order to get construction material into the mountain fastnesses it was necessary to construct the Hetch Hetchy railroad. The City built 68 miles of standard gauge system, starting at a junction with the Sierra Railway in the foothills. This road follows in a general way the line of aqueduct. A total of 300,000 tons of material will have been carried on this road before the project has been completed.

The road has also acted as a common carrier, transporting lumber from new mills in the adjacent forests and other freight for local inhabitants. While being constructed for carrying materials into the project, this road is probably one of the most scenic railways in the United States, running through a wild country where all manner of wild game can be seen from the trains and along the edge

of mountains overlooking sheer cliffs of several thousand feet.

Another obstacle encountered in the construction was the character of rock on which the foundation was placed. Most of the foundation work is 60 ft. below river bed, while some of the work is placed at a depth of 118 ft.

In beginning the work of construction, the Tuolumne River was by-passed from the site of the proposed foundation through a tunnel 25 by 25 ft. Four supplementary dams were needed to reach a foundation. A log crib dam was placed 200 ft. above the foundation site to divert the water through the tunnel. Then a down-stream dam was constructed to keep the water from backing into the pit. Two additional slender dams were then placed in the pit at a depth of 40 ft. to intercept water and gravel from coming into the bottom of the pit until the foundation had been reached.

Grooved pot holes were encountered at the bottom which were covered with the scum of centuries. A sandblast and brushes sufficed to clean off the granite base for a desirable contact for the concrete.

In August, 1921, the excavation work was completed and concrete was poured into the forms at the rate of 25,000 cu. yds. a month. This was continued until the day of the dam's completion, March 23, 1923.

Another large task in the construction of the project was the necessity of drilling an 18-mile tunnel through the Sierras, 9 miles of which will be lined with concrete.

More than 500 persons have availed themselves of the week-end excursions being promoted by the office of City Engineer O'Shaughnessy to the Hetch Hetchy reservoir and O'Shaughnessy Dam since its completion.

A special train leaves San Francisco every Friday evening, arriving at the damsite Saturday morning and leaving the dam site Sunday afternoon and arriving in San Francisco early Monday morning.

Under plans of the City Engineer's office a different group of business and professional men and women will be taken to the project each week. The trips are under the direction of Assistant Superintendent L. B. Cheminant of the Hetch Hetchy Railroad and can be made at a nominal cost.

NEED OF PROPER MAINTENANCE OF IMPROVED ROADS

By John S. Crandell, Consulting Engineer, The Barrett Co., 40 Rector St., New York, N. Y.

The Canadian Good Roads Association has for its slogan "Adequate Maintenance Means Road Economy." That is a pithy statement of fact. It would be well to teach it to school children so that it might be implanted in the minds of the maturing generation. There are many adults who never seem to be able to grasp the idea that road maintenance is a necessity. There are many voters who are willing and anxious to spend money for road construction but who are aggressively against any road mainteance fund. The task of educating these people to realize that adequate maintennance means road economy has been and continues to be difficult in the extreme. If we can start with the children and instill in them the idea of maintenance then a large share of our worry will be done away witth.

Severe Test of Roads

During the past year, winter and traffic combined have put our roads to the most severe test possible. Those roads that have consistently received careful, painstaking and intelligent upkeep have come through the ordeal in first class condition, while those that were slighted, skimped and neglected are now close to ruin. Last winter was especially severe, and traffic never was so heavy, so it was certain that only the best could come through intact. There was no type of improved road that was not injured, and in many cases the damage to the high cost roads was much greater than that done to the cheaper types. Many people still have the notion that because a road is expensive in first cost that it will be perfect forever and ever. Therefore maintenance is disregarded until suddenly the pavement breaks up so badly that reconstruction is necessary.

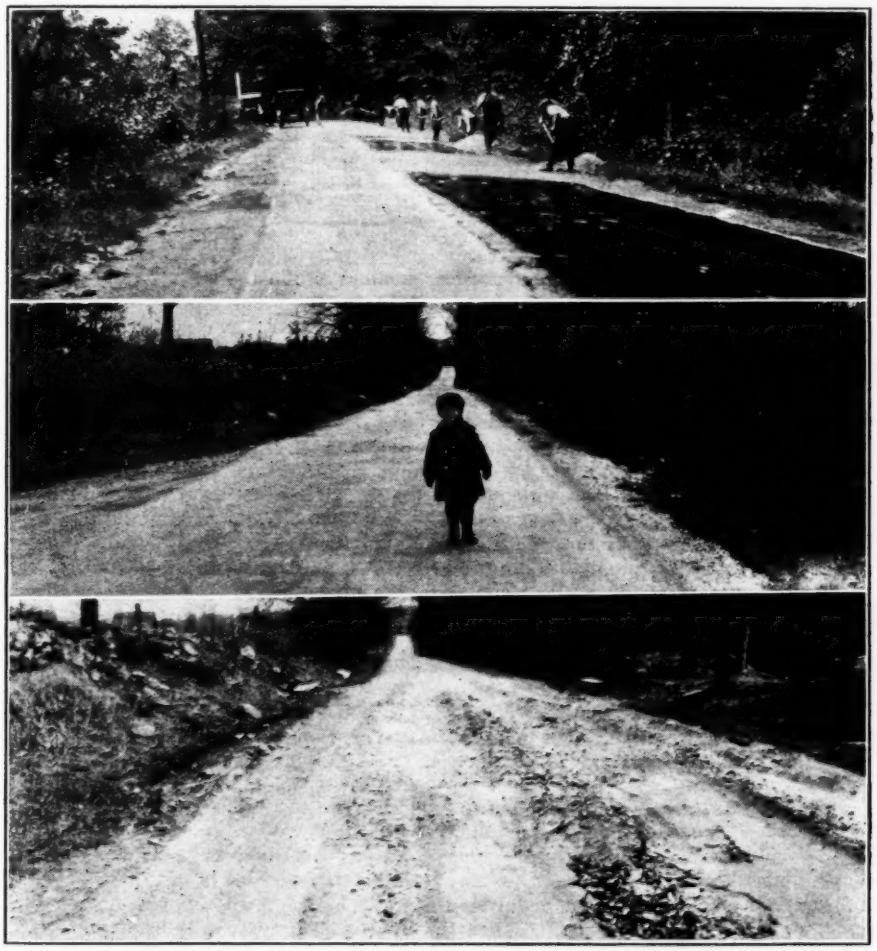
There are fertile regions in both Canada and the United States that are almost without inhabitants because the highways are so poorly maintained that communication with the markets is costly, difficult, and sometimes impossible. Municipalities are the natural markets for the farmer, and the townsman must take as much interest in the country roads as he does in his own municipal thorofares. Nor may he neglect the town streets, thinking to use the provincial highway system when he wants to ride. All too often the motorist leaves a splendid country

road and enters a wealthy city over really abominable pavements.

Value of Well Trained Maintenance Crew

The trouble with most roads and pavements is not faulty construction but lack of adequate maintenance. It is not necessary in the smaller cities to keep an expensive maintenance crew of a large number of men working all the time But you must have a small gang trained to maintenance work, on whom you can depend for faithful service. This gang may be used for construction work, too, but its primary reason for existence is to be ready any day to maintain the highways. When a break in a pavement appears this gang of three or four men will immediately patch it. When chains on motor cars wear ruts in the surface of the pavement these men will repair the damage immediately. When the small boy builds a bonfire on the new road the gang will be on hand next morning to remove the burned pavement and patch. When the weather is bad the gang will be making up cold-patch mixtures to be used when the weather is good. And when they have all the pavements in town in first class shape they will be turned over to construction work until they are again needed on maintenance.

Townships and counties need maintenance gangs or maintenance men just as much as the towns. The more progressive localities have realized this and



VIEWS SHOWING THE BAD EFFECTS OF POOR DRAINAGE.

Upper View Shows Concrete Road at Spring Valley, N. Y., Built in 1912, Being Covered with Tarvia A and Limestone Chips in July, 1922. Middle View Shows the Condition of the pavement in November, 1922. Lower View Shows the Same Place in April, 1923. The Pavement at this Point is in a Cut and Water Seeped Under the Slab and Heaved in Freezing. Only this Section was Damaged; the Rest of the Pavement Came Through the Winter in Perfect Condition.

they are cashing in on their foresight now. Traffic is coming their way; their hotels are full, their merchants are doing good business, their farmers are prosperous, and the towns are in flourishing condition. But let maintenance slacken ever so little and a difference will immediately be felt. Trade lags, tourists stop, farmers travel less and stagnation appears.

We must have good roads, and that means we must maintain them.

As traffic increases, the task of maintaining our improved roads becomes greater and greater, and the longer we defer maintenance the more formidable it grows until finally, if we wait too long, it is a matter of reconstruction rather than maintenance.

Maintenance and Reconstruction

How shall we differntiate between maintenance and reconstruction? Is there any line of demarkation between the two? Can we say that if we apply surface treatments of tar to macadam or bituminous or concrete roads that that is maintenance, but that if we apply a 2 in. wearing course over an old road that is construction or reconstruction? There are a number of road authorities who believe that once the road is constructed it is always a question of maintenance, no matter what is done to the road, unless there is relocation and new drainage. This is the extreme view, and probably most highway officials will not concur in it.

Pavement Characteristics

Pavements are as individual as persons. Some stand up and take punishment under adverse conditions for a long time before they fail, and then they go all to pieces. Others fail gradually, a hole develops here, a wave there, a stone comes loose, a slight depression, and slowly the pavement becomes worse and worse until it is almost impassable. Some go bad in spots, just as a man becomes bald. Some, like the old cow, just "give out" from no apparent cause. Some begin to crack and break up as soon as they are laid, while others scale and peel as though they had some skin disease. And you never can tell how they are going to act, even though you know all the facts about their construction, because traffic and weather may bring about conditions wholly unforeseen.

New or Carcless Maintenance Gangs

But as soon as trouble is noticed, maintenance of the most painstaking kind should be begun. Now I said "painstaking, and I mean just that. An examination of the roads throughout the eastern part of the United States this Spring convinced me that the maintenance gangs have either grown careless, or that new gangs are at work who do not know their business. The patching, filling of cracks in concrete, cleaning of ditches and culverts, repairs to guard rails, and the upkeep work in general is not nearly so good as it was a year ago. While I admit that there has been vastly more of it to be done this year, and that the men have had to work faster to keep up with the breakdowns, it still remains a fact that the work has, in many cases, been carelessly done, with almost total disregard of instructions.

Patching With Refined Tar

Successful patching with refined tar does not call for any great skill, but it does call for a lot of common sense. And to be quite successful in this class of work a little experimenting should be encouraged. Tarvia KP, which is so extensively used for cold patching, is a uniform product, so that no matter where it is purchased, it will be found always the same. But the tar that goes into a patch is only about 10% of the total material. The other 90% is stone and sand or stone alone. Stone varies with its location in the quarry as well as with its geographical position, yet many road men take no heed of this variation, and make up all their batches of patching mix as if the stone were as uniform as the tar. Sands, too, vary greatly. There are hard sands, and soft sands, sharp sands and round sands, clean sands and dirty ones. It stands to reason that a hard stone, like trap, will not produce the same kind of mix that a soft limestone will. Nor will granite, another hard stone, act like trap. Nor will all granites act similarly. Then again, the sand that is generally used in the mix will make considerable difference in the way that the stone itself acts. A little experimenting will enable you to determine what is the best proportion of materials to use. Then, having found by trial the best mix, stick to it, and make all your other mixes with the same materials and in the same way.

Many of the soft limestones need no sand. The sand is a filler to fill the voids between the pieces of stone, but when soft limestone is used there is considerable fine material worn off the stone which takes the place of sand. This is not the case when the harder stones are used. A mix made of hard stone alone will usually be unsatisfactory because the patch will be an open mix, water can

enter it, and disintegration is almost certain to result.

There are a few roads that require patching only. There are others that require more extensive maintenance. Patching takes care of actual breaks, while a surface treatment saves the surface and keeps the pavement intact.

Tar Surface Treatment of Concrete Roads

New York State during 1922 maintained many miles of concrete with tar surface treatments. In this work both hot tar and cold tar applications were tried. The hot tar seems to provide a more durable coating, and a mat is built up of considerable thickness. The hot applications require greater care, both in original work and in maintenance, but the results seem to indicate that such care is well repaid. Where hot applications are made it is necessary to cover the tar with ¾ in. hard, tough stone chips. A sand cover will not do. The large sized chips are rolled into the tar where they are anchored fast. The large chips prevent any waving or bunching of the tar coating, and they also provide an excellent surface for both motor and horse drawn traffic. Such a surface is really skid-proof.

Amount of Tar Used

The amount of tar used for the hot surface treatments is about ½ gal. per sq. yd. of surface. This is sprayed over the concrete in one application. Sometimes it is better to give the concrete a priming coat of cold application tar at the rate of ¼ gal. per sq. yd., following this with 1/3 gal. of hot tar. This method will be found to be best when the concrete is scaling badly or where the laitance is not worn off evenly. When cement concrete sets there is a sort of scum that rises to the top, forming a layer much like icing on a cake. This is called laitance. It wears away in the course of time leaving the aggregate of the concrete exposed to traffic. It is then that the tar surface treatments are necessary and advisable. But do not attempt to surface-treat a new concrete road unless the laitance is removed in some manner, for the tar will peel up with the laitance, leaving the concrete unprotected.

If the concrete wears so badly that a surface treatment does it no particular good, then a 2 or 3 in. tar penetration macadam toppng should be laid over the concrete. If the concrete breaks up in springtime it is a sign that drainage is the fault, and no top or maintenance of any kind will help. During March and April of this year I saw many concrete slabs badly heaved and broken because the soil had not been properly drained before the pavement was laid. There is, of course, no way of maintaining a pavement of any kind under such conditions. It is useless to put a tar wearing course on top of a poorly drained concrete road, for if the concrete heaves and cracks so will the top.

The Macadam Road

The macadam road is by far the best road for horse drawn traffic, but the macadam road, as all very well know, does not last under motor cars, unless it is protected by giving it some kind of a bituminous surface treatment. Then, with careful maintenance, there is no good reason why a macadam will not last indefinitely unless heavy motor truck traffic appears.

Immediate Repair of Surface Breaks

Macadam may be either water-bound or tar-bound. The latter type, of course, gives a more lasting and stronger pavement. Maintenance is carried out in the summer for both types. It is extremely important that all surface breaks be repaired as soon as they appear. For this purpose it is wise to keep on hand a few barrels of light refined tar so that patches may be made at any time. Some states scatter barrels of patching material along the roads, so that the repair men may have a handy supply. The barrels should have a tight fitting cover to keep out dirt. At convenient places there should be kept supplies of stone. There will be no excuse for roads not being always in good condition, provided the drainage is right.

Practice in One Small City

Every year or two the road should be surface treated with light refined tar applied at the rate of from ½ to ⅛ gal. per. sq. yd. The amount varies with the condition of the road to be treated. New waterbound macadam requires about ½ gal. for the first treatment. This should be reduced each year until the thinnest coat that will protect the road is applied. One of the best paved small cities I ever saw was in Pennsylvania where nearly all the streets were built of waterbound macadam and treated yearly with Tarvia B applied at the rate of 1/10 gal. per yd. The streets were always in perfect condition, and the cost of maintenance was less than 2 cts. per yd. per year. This was before the war, but even now the cost is not 3 cts. The business streets are tar macadam, and are surface-treated annually. The low cost resulted from the city engineer sitting personally on each

job day in and day out, and the excellence of the work was due to the same cause.

Avoid Heavy Mat Coats

It is a mistake to apply too much tar year after year so that heavy mat coats are built up. Often it is better merely to patch the breaks, and surface treat every two or three years. I have seen failures come where the engineer insisted on treating little used streets with ½ gal. per yd. yearly. Unless the road is flat it is difficult to apply as much as this to a surface that has had a treatment, for the tar will run to the gutters. Excessive maintenance like this may be worse than none at all.

Tar-bound and asphalt roads require surface treatments from time to time. Asphalt may be kept in good condition with an occasional tar surfacing. The tar surface treatments over asphalt prolong the life of the asphalt in a rather odd way. Oils from motor cars soften asphalt to such an extent that on heavily travelled streets rutting occurs. Ruts over an inch in depth are often formed and it is impossible to roll them out or to harden asphalt. Tar is not affected by the oil and it therefore oil proofs the asphalt and prevents it from ruttting, bunching and pushing.

The foregoing is from an address before the recent Convention of the Union of Quebec Municipalities.

COMMENTS ON THE COLORADO RIVER PROBLEM

By C. E. Grunsky, Consulting Engineer, 57 Post St., San Francisco, Calif.

Among the larger of the domestic problems with which this country is immediately concerned is the Colorado River problem.

International Aspects of the Problem

By inaction the international aspect of this problem is annually growing more serious. As advisor to the Secretary of the Interior on such matters the writer in 1907 called attention to an intolerable situation and suggested a plan of procedure to prepare the way for the pending interstate and international projects. It is perhaps not generally known that by indirection rights are held by the Imperial Irrigation District of California, through a subsidiary Mexican concern on foreign territory, entirely without treaty sanction or protection and subject to conditions which may become embarrassing if a suitable treaty arrangement with Mexico be too long delayed.

The Interstate Pact

The Colorado River problem can not be solved without giving proper consideration to the fact that this river is an international river. The interstate pact, recently agreed to by a commission composed of a representative from each of the seven states in the watershed of the river and Mr. Herbert Hoover, as representative of the United States, and now ratified by all of the watershed states except Arizona, is only a first step toward the solution of the problem. If conflicting interests between upper and lower groups of states are to be recognized as indicated in the pending pact then, too, the states within the two groups may well ask as does Arizona, "What will be the situation 40 or 50 years from now?" Each of the states in the upper group is interested in knowing what proportion of the water agreed to be left in the river for the use of the lower group it will be expected to furnish—just as each of the states of the lower group may desire to know at the outset what proportion of the water and what proportion of the power output will ultimately fall to its share.

The Position of Arizona

It is not surprising then to find Arizona, with a limited area only that can profitably be covered with water, in the attitude of wanting to know. There is some basis for the fear that if, for example, the Boulder Canyon dam be constructed and a power plant be there placed in operation, the predominating benefit will go to those regions where industries are already well established—that the southern portion of California will absorb an undue proportion of the energy made available at the cost of Arizona's future. A similar fear is expressed in the matter of the beneficial use of water for irrigation. Who, if there be no understanding on this point in advance, shall prevent the extension of irrigation to the most favorably located lands regardless of state boundaries to the exhaustion of the water supply, thereby possibly depriving one state or another of making developments which, though perhaps not immediately attractive from an economical standpoint, may yet be of equal or greater value in a broad scheme based on ultimate greatest good to the greatest number?

Interstate Power and Irrigation District

No reasonable regulation of the flow of Colorado River by storage appears feasible except under control of some higher authority than that of the individual

state. This principle has already been recognized in the creation of the Commission which has formulated the interstate pact. The federal government is the agency that should logically be looked to, to effect the regulation and to apportion the output. But, there may be objection to the vesting of this control in the United States, burdening the nation with a problem which primarily concerns the Southwest, and some thought must be given to the alternative to which attention was called in a recent address by Governor Scrugham of Nevada, at a meeting of the Pacific Coast Electrical Association, which provides for the formation of an interstate power and irrigation district. This is a practical suggestion and if those who are directly interested prefer the district control to federal control, why not?

The Time Element

An interstate district, however, could not, any more than the United States, prevent development along the lines of least resistance regardless of state boundaries unless there be some prearrangement between the states to restrict undue demands upon water and power output in the localities whose other facilities are already well developed. The time element must, in other words, be taken into account and the desirable ultimate conditions must be forecast and carefully weighed. State boundaries will have to be considered although it is self-evident that in such large problems as that of the Colorado River the ideal solution should be independent thereof, except that their recognition may aid in securing desirable widespread, rather than concentrated, utilization of both water and power.

How Much Water Should Go to Mexico?

But it must not be overlooked, as already stated, that the Colorado River problem is an international problem. We may take satisfaction in the knowledge that the water in this river originates in the United States and that if we retain and use it all within our own borders our neighbor to the south would have to be content with a protest. This will never happen. Thus far we have failed to set a limit to the amount of water which is ultimately to be allowed to flow into Mexico and the irrigated area in Mexico has been growing apace. On this subject our government was warned, as already stated, in 1907, when Colorado River water was used in Lower California on less than 10,000 acres. Now the irrigated area in Lower California is about 200,000 acres. What shall be the limit, and what agency other than the United States can fix the limit?

Here is a case where the limit is not set by the physical features of the country, but solely by the quantity of water temporarily and ultimately available.

Inundation Dangers

And again, the Colorado River menaces certain areas within the United States with inundation when its waters run wild. The great menace is to the lands of the river's delta lying both in the United States and in Mexico and the points where this menace must be fought are in Mexico. To be sure the frequency of floods can be materially reduced and the rate of channel deterioration by silt deposits can be materially decreased with such works as the contemplated Boulder Canyon dam, but some of the flood waters originate in portions of the river's watershed below Boulder Canyon and these would still remain to keep acute the situation in the river delta beyond our boundary.

Federal Control of Proposed Large Reservoirs

Owing then to this international aspect of the question the United States should remain in control of any proposed large reservoirs on the Colorado River even though construction and operation thereof subject to government regulation be delegated to a district, to a state, to a group of states, or to a private corporation. It will remain incumbent on the United States to arrange for the manipulation of reservoir gates in such fashion that the flood menace will be reduced to a minimum and that interstate and international obligations will be respected.

PROPOSED ELECTRIFICATION OF THE AUGUSTA, GEORGIA, POWER CANAL

By Nisbet Wingfield, Consulting Municipal and Hydraulic Engineer, Marion Bldg., Augusta, Georgia.

The City of Augusta, Georgia, is located on the Savannah River, which stream forms the boundary line between the States of Georgia and South Carolina. It is where the Fall Line joins the Costal Plain, and is at the head of navigation, 202 miles by river from the Port of Savannah, Georgia. It is one of the old Southern towns, being established as a trading post in the Colonial Days, and incorporated as a town shortly after the Revolutionary War.

Character of Business and Industries

The people of Augusta are conservative, but industrious, and have built up a community which is not only sound socially but industrially. It is a noted tourist resort, but this is merely by-the-way, as the business of the community does not depend on tourists.

The most important business is the handling of raw cotton and its manufacture into cloth. Approximately one-half million bales of cotton are marketed in Augusta each year, and much of this is used by the various cotton mills in the city and immediate suburbs.

River steamers are operated from Savannah to Augusta. These make connection at Savannah with ocean-going vessels, and in this way an all water freight rate is established between Augusta and Eastern ports. Cotton and cotton goods are shipped from Augusta in this way, and miscellaneous freight brought back. Owing to the advantageous freight rates, jobbers of all kinds of merchandise can operate from Augusta to advantage.

Another important industry is lumber, there being many planing mills and woodworking establishments. These are supplied from saw mills cutting long leaf and short leaf pine in the immediate vicinity. There are also boiler works, machine shops and various industries usual in a city situated as Augusta is, supplying a large territory surrounding it.

Present Sources of Power

Practically all industries in and around Augusta, including cotton mills, are operated either by electric power or by water power, applied direct to the shafting by means of water wheels, as is the case with the industries supplied from the Augusta Power Canal, which will be described more in detail below.

There are two sources of power; one is a hydro-electric development made by damming the Savannah River eight miles above Augusta, where a fall of 28 ft. net is obtained, and 16,000 electrical horsepower produced. This was constructed, and is owned, by a corporation chartered as the Georgia-Carolina Power Company. The other is what is known as the "Augusta Canal," a development made many years ago, before any one had heard of, or thought of, electric power and transmission lines. The Augusta Canal furnishes a total gross power of 12,000 horse-power.

Need for More Power

The entire capacity of both of the above mentioned developments is now being utilized by existing industries and street lighting. Applications are constantly being made for power from prospective consumers who desire to build in or near Augusta, and from existing consumers who desire to increase their plants.

Augusta being quite a distance from the coal fields, it is not practicable to put in steam plants and compete with electric power developed in the immediate vicinity, so that if the city is to grow and increase its commercial importance as it should, it is necessary to develop an additional supply of electric power.

How Additional Power Can Be Obtained; Possible Sites for Hydro-Electric Development

A study of the topographical maps of the Savannah River Basin and profiles of the main streams, all of which were available, discloses a number of sites where hydro-electric developments could profitably be made.

The total areas of watershed above Augusta is 7,295 square miles. This extends back to the foothills and mountains of the Blue Ridge Range, reaching an extreme elevation of approximately 4,000 ft. above sea level.

The fall is quite rapid from the upper end to the Piedmont Plateau, where the elevation is about 1,000 ft. From that elevation to elevation 100 (which is zero on the river gauge at Augusta), the fall is more gradual, but there are a number of rapids and shoals offering excellent opportunities for development.

From Augusta to Savannah the river passes through the costal plain, the fall averaging only about one-half foot to the mile, so there is no opportunity for development below Augusta.

The drainage system above Augusta consists of the Chattooga and Tallulah Rivers, which form the Tugaloo, and the Tugaloo and Seneca which form the Savannah. The principal tributaries below the junction of the Tugaloo and the Seneca, are the Broad River from the west and Stevens Creek from the east. The fall in the Tugaloo from the junction of the Tallulah and Chattooga to the junction with the Seneca River (a distance of 50 miles), is 260 ft. From the junction of the Seneca and Tugaloo to the Georgia-Carolina Power Company's Pond (a distance of 80 miles), the fall is 300 ft.

The fall from the Georgia-Carolina Power site to Augusta, seven miles, is 50 ft.

On the Savannah River and tributaries above Augusta, there are 18 possible sites for hydro-electric plants. Some of these, in the upper reaches, have too small

drainage areas to make them of much value alone, but as a part of a general scheme they would become of great value, as the power at any given plant is increased by each development above it, on account of the increase in pondage to be drawn on during periods of low water in the river.

Development for large powers must necessarily be located on the lower reaches of the main stream in order to have sufficient drainage areas to insure a reasonable flow during dry seasons.

If all developments commercially possible were made on the Savannah River and tributaries, the total power thus secured would be more than 200,000-h. p. No other stream in this section of the United States has such possibilities.

With this fact clearly demonstrated, and it has been by numerous surveys and reports made both by the United States Government and individuals, it seems peculiar that more power developments have not been made in this basin; but the cause of this is clear, if unjustified. Every attempt made by individuals or corporations organized for the purpose of developing these powers, to finance a proposition, has been met with the statement that there was no market for the power within a reasonable distance of the development, and the prospective bond buyers and underwriters (with whom negotiations had been opened) stressed the fact that the quantity of power furnished by the "Augusta Canal," and the low rate at which it was delivered to the mills, made it impossible for any other development to compete in Augusta.

The prerequisite for considering the financing of a proposed development was that actual contracts for the power must be obtained in advance of improvement. This was manifestly impracticable, as the power must first be available before new consumers could be found.

The Georgia-Carolina development at Stevens Creek on the Savannah River was financed by obtaining a contract from the Augusta Railway & Electric Co., by the terms of which the Railway & Electric Company obligated itself to pay annually a sum sufficient to meet interest on all the Power Company's securities. It required several years to find consumers for the power, but all has now been sold.

From the above it will be seen that it will be difficult to induce the owners or promoters of any of the privately owned sites of the Savannah River watershed to develop any of their properties, on account of the difficulty or impossibility of financing the construction, so that it is evident that additional power, if any, must be provided by the City of Augusta itself. The cheapest and most sensible method of doing this is by converting the old antiquated August Power Canal into a hydro-electric plant.

The Original Power Development by the City of Augusta

In 1845 certain influential citizens of Augusta decided to go into the manufacture of cotton goods, and for this purpose to utilize some of the power in the Savannah River. In the first seven miles above Augusta there is a fall in the river bed of approximately 50 ft. The scheme evolved was to build a canal with a low gradient from a point about seven miles above the city down to Augusta, and utilize the fall from this canal to the river for the development of power. In those days, of course, hydro-electric development was unknown. A canal was constructed connecting with the river above the city, followng the hillside to Augusta.

The dimensions of this were 40 ft. surface width, 20 ft. bottom, and 5 ft. deep. A timber diverting dam was put across the river at the upper end to force the water into the canal. A head of approximately 32 ft. was secured, affording a total mechanical effect of about 600 h. p. This amount of power soon proved inadequate to the demands, and as the plant functioned perfectly, it was decided to enlarge the capacity, but for reasons now unknown, this was not done until after the Civil War.

The Present Power Development

The enlargement was finally authorized in 1872. The work was commenced in March of that year, and completed in July, 1875. The new development was along the same lines as the old. The extreme low flow of the river at Augusta is 2,300 cu. ft. per second. This stage of water has occurred only once. The annual low flow is between 3,000 and 3,400 cu. ft. per second, the ordinary summer flow is 5,000 cu. ft. per second. At flood periods this is largely increased, the record flood (1908) being 300,000 cu. ft. per second, or 100 times the ordinary low flow. It was decided to construct a canal capable of delivering to Augusta the ordinary low flow of the river that is, 3,400 cu. ft. per second.

A stone masonry diversion dam was constructed across the river from the Carolina shore to the Georgia shore, just below the old timber dam. The spillway

is 1,700 ft. long and the crest is at such elevation as to maintain 11 ft. depth of water in the canal. The minimum waterway in the canal is 150 ft. at the surface, 106 ft. at bottom, and 11 ft. deep, making an area of cross section of 1,408 sq. ft. The length of the canal is 7 miles. There is a bottom grade or descent in the main canal of one hundredth of a foot in 100 ft. This will give, theoretically, a mean velocity of 2.75 ft. per second. The flow into the canal is controlled by head gates with a combined area of openings of 1,463 sq. ft. One side of the canal is an embankment constructed along the river of materials excavated from the canal channel. The other bank is the natural soil. There were several small streams flowing into the river in the distance of seven miles covered by the canal. Where these were encountered flood gates were placed in the canal bank. In ordinary operation, however, these are closed, and the creek or branch water flows into the canal. If the rainfall is of such intensity as to raise the water level in the canal to a danger point, these gates are opened.

In addition to the gates several spillways have been provided with a total length of approximately 300 ft., the top of the spillway being 6 ins. above the established flow line in the canal.

Method of Utilization

From the diversion dam above the city down to Augusta, there is a rapid fall in the bed of the river, the total difference in the elevation being approximately 50 ft. The fall in the canal for the same distance is 3½ ft., so that difference in elevation of water in the canal and river increases from nothing at the Locks to 46½ ft. at Augusta. At points along the canal where differences in elevation between the canal and river are sufficient, various industries have been established, located between the canal and the river. The agreement between these industries and the City of Augusta (owner of the canal), is that the city will furnish and the industry pay for, water at the head gates, which are constructed in the banks of the canal. Water is drawn through these gates and head races to the water wheels and tail water goes to the river. The city makes an annual charge of $5.50 per h. p. year, for 11 hours per day. This is for theoretical water power at 100% efficiency, regardless of loss from friction or head at which water is used. The city's charge is based on horse power developed, and not on quantity of water or head available, the actual head only being taken into consideration in determining the charge. As the cost of the entire development, including head gates, head race, wheel pit, water wheels and tail race, is paid by the consumer, this basis of charge encourages uneconomical use, and in consequence, many of the industries have not utilized the full head available.

The Augusta end of the canal is so located that it is impracticable to get tail race from the industries direct to the river, and it was found necessary to build an intercepting canal, known as the "Second Level," into which the tail water from the factories located in the congested districts emptied. The industries so located have a head of only 15 ft. There are a few small plants which take water from the "Second Level," and empty into a "third level," which is merely a drainage canal, flowing into the river.

In each case, both on the first and second levels, the industries have made their own developments. Two of the cotton mills have electrified their plants, using the water obtained from the city to operate plants of their own.

Loss of Available Power by This Method

The present method of obtaining power from the Augusta Canal is not only antiquated, but wasteful in the extreme. In the first place, only one mill has developed power in such a way as to utilize even approximately, the entire fall available. There is a further waste of power thus developed in the manner in which it is transmitted to the machines. The water wheels mechanically drive line shafts, entailing high frictional loss, in some instances in the larger mills amounting to 40%. There is a further loss entailed when only a portion of the machinery is being operated, instead of the full load, the factories drawing practically a constant amount of water regardless of any variations in their loads.

The loss of power due to insufficient head is especially noticeable on those mills, four in number, taking water from the first level, and discharging tail water into the second level, with available fall of only 15 ft. These mills use 1,188 cu. ft. per second to develop 1,571 h. p. or 1.32 h. p. per cu. ft. of water. The mills discharging tail water directly to the river, consume 2,219 cu. ft. to develop 10,615 h. p. or 4.78 h. p. per cu. ft. of water.

In addition to the above there are losses due to depreciation and upkeep of numerous head works, gates, flumes and

other parts of the plants as against similar losses in one central station.

Development Proposed

In order to make available the power which is lost through the present system, which power could be used for additional industries, it is proposed to build a single new hydro-electric power plant near the foot of the shoals at Lake Olmstead, 4½ miles below the diversion dam, where a net head of 38 ft. can be obtained while the plant is in operation, the head water to be taken from the canal. Below this point the canal would be abandoned, but all the mills now drawing their water from the canal would, in lieu thereof, be supplied with electric power at a price to be agreed upon.

From this central plant a transmission line would be run along the canal. As the power obtained from the old system costs the users considerably in excess of $30 per h. p. per year at the machines, in spite of the fact that the initial cost of water is only $5.50 per h. p. it will not be difficult to reach an agreement as to the price of electric power which will enable the city to cover all costs of operation, depreciation and interest.

Possibilities of Increase in Power

The capacity of the canal as now constructed is 3,400 cu. ft. per second—the fall at the point selected for generating station is 38 ft. net. This will make available, after deducting transmission loss, approximately 11,000 electrical h. p.; 7,000 h. p. will operate the machinery in all the mills as it now exists, leaving a surplus of 4,000 h. p. to be sold. In addition to this, the capacity of the new plant can be further increased by raising the head of the water at the locks, thus increasing the delivering capacity of the canal. An 18-in. additional head can be obtained by raising the height of the dam across the river, which can be cheaply done, as the dimensions of the dam are such that 18 ins. can be placed on top without endangering it. It will be necessary also to raise the canal bank 18 ins. to 2 ft., a distance of 4½ miles from the locks to the power house site. This can be done with earth excavated from land side of canal. If this is done a total of 4,900 cu. ft. per second can be delivered at the power house, thus adding an additional 4,800 h. p. This additional amount of water will be available, although it is in excess of the low flow of the Savannah River, on account of the pondage by the Georgia-Carolina Power Company, which has a dam across the river, one mile above the city's diversion dam. During the day run the volume of tail water from this plant is approximately 5,000 second feet.

Effect on Present Users of Power

If the mill machinery is electrically driven, instead of the hydraulic drives at present, there will be a saving to the manufacturer in several ways.

It is a well known fact that power applied direct to the machines will give a more uniform speed than can be obtained from long lines of shafting driven from one end by water wheels. Uniformity of speed insures a better quality of cloth, and there will be less loss due to defective weaving.

It is also true that actual energy necessary to drive a certain set of machines is little more than one-half, if power is directly applied to machines, of the gross water power necessary to drive the water wheels mechanically connected to main driving shaft, which in turn drives countershafts, belted to machine units.

The cost of operation and upkeep of head and tail races, head gates, water wheels and all accessories will be entirely eliminated. This is a large item in any plant which has been in operation for some time.

On account of the reduction in operating expense due to decreased gross power required, and elimination of expense of operation and upkeep of the hydraulic drives, and the reduction in losses due to variable speed, the user can afford to pay such a price for the electric power as will enable the city to make the development.

Advantages to the City

The advantage to the city will be the fact that the mills and other industries which now utilize the entire power of the canal as at present developed, can be furnished with electric power sufficient to run all existing machinery and still leave a surplus of power to be sold to new industries, or for increasing any existing industries.

The rate to be charged for electric power will be such as to pay the interest on the cost of development, and this will in no wise be a hardship on the user, in view of the fact that a less amount of power will be required. It is necessary for the further development of the city that additional power be secured, and the power development referred to above can be made quicker and cheaper than in any other manner.

Present Status

The City Council of Augusta is desirous of making this improvement on its own account, thus retaining control of the

power situation in Augusta as at present, the object being to make rates as low as consistent, in order to encourage the erection of new manufacturing industries.

There is also before the City Council for consideration, a proposition from private interests to furnish the necessary capital to make the hydro-electric development from the canal, a corporation to be formed to control the power, the city having one-half interest, and those making the development one-half interest.

This latter method has been proposed in view of the fact that the constitutional limit of indebtedness for municipalities in Georgia will be exceeded if the city makes the development itself, requiring certain changes in State laws. There are, as usual, advocates among taxpayers for both plans. Which plan will be adopted has not been determined, but the improvement will no doubt be made one way or the other.

In the foregoing I have purposely avoided all technical terms and discussions—my idea being merely to present a situation which, in my experience at least, is unique.

AN IMPORTANT HYDRAULIC FACTOR IN CULVERT DESIGN

By C. E. De Leuw, Kelker De Leuw & Co., Consulting Engineers, Conway Bldg., Chicago, Illinois.

Design of culverts with due regard for their hydraulic properties has seldom been attempted in the past. The ever increasing scale of labor and material costs is causing the designing engineer to make a more critical examination and analysis of his designs of all structures. Culvert designs have generally been made on the basis of waterway opening required without regard to the effect of friction losses of different materials upon the velocity of flow. In the last few years there has been an increasing amount of discussion of friction losses as well as other hydraulic factors which affect the capacity of culverts.

The Iowa Experiments

A comprehensive investigation on the flow of water through pipe culverts was conducted at the hydraulic laboratory of the State University of Iowa during the summer of 1922. Tests were made on commercial corrugated metal pipe of 12, 18, 24 and 30-in. diameter. To determine the effect of the length of the culvert on flow, the 24-in. pipe was tested in 24, 30 and 36-ft. lengths. The other sizes were tested in 30-ft. lengths only. The number of tests (almost 1,000) warrant considerable confidence in the results obtained. The experiments were conducted by D. L. Yarnell, Senior Drainage Engineer, Bureau of Public Roads, U. S. Department of Agriculture, and Sherman M. Woodward and Floyd A. Nagler, Professor and Associate Professor, respectively, of Department of Mechanics and Hydraulics, State University of Iowa.

These investigators made a study of a number of hydraulic factors in culvert design such as entrance losses for different types of entrances, effect of carying elevations and culvert and the coefficient of roughness "n" in Kutter's formula. From these experiments, the following average values of the coefficient of roughness were found.

Diameter of Pipe Inches	Kutter Co-efficient Corrugated Metal Pipe
12	0.019
18	0.022
24	0.022
30	0.023

Earlier Tests

These results check with the somewhat meagre data obtained prior to these tests for corrugated metal pipe. In 1913 Cone, Trimble and Jones conducted tests on a semi-circular corrugated metal flume having an arc length of 132 ins. and a total length of 1,745 ft. The coefficient of roughness ("n") obtained varied from 0.0196 to 0.027, depending upon whether the flow was measured on a tangent or on a curve. In 1917 the Bureau of Public Roads conducted tests on 8-in. and 10-in. corrugated metal pipe 200 ft. in length. The coefficient of roughness ("n") obtained for the pipe flowing full varied from 0.017 to 0.021.

There is an abundance of data available on the values of "n" for concrete pipe. Many tests have been made not only in the laboratory, but also in the field on structures of great length and built under varying conditions.

Data From Bureau of Public Roads

The Bureau of Public Roads of the United States Department of Agriculture published Bulletin 852 on "The Flow of Water in Concrete Pipe" in 1920 which contains the data gathered from a great many tests. Many of these data were from the records of the U. S. Reclamation Service and also from the leading consulting engineers in many sections of the United States and Canada. Tests of many existing concrete pipe lines, including the Victoria, B. C. Aqueduct which is 42 ins. in internal diameter and 27 miles

TABLE I—DISCHARGE OF PIPE CULVERTS ON A ONE PER CENT. GRADIENT.

Internal Diameter of Pipe Inches	Water Area in Square Feet	Discharge of Corrugated Metal Pipe in Cubic Feet per Second	Discharge of Concrete Pipe in Cubic Feet per Second	Carrying Capacity of Concrete over Corrugated Metal Pipe Percent
12	0.79	1.83	3.40	86
15	1.23	3.44	6.35	85
18	1.77	5.70	10.17	79
24	3.14	12.70	22.78	79
30	4.91	23.60	41.73	77
36	7.07	39.10	68.22	75
42	9.62	59.45	102.93	73
48	12.57	85.84	147.44	72
54	15.90	118.14	201.61	71
60	19.64	157.91	267.30	69

in length, are presented. This Bulletin is the most complete and authoritative work on the value of the coefficient of roughness for concrete pipe. After reviewing all data presented, the following suggestions are made for "n" in Kutter's Formula:

Class 1. (Old California cement pipe lines.) n=0.013 for pipes up to 10 in. in diameter.
n=0.014 for pipes from 12 to 24 in. in diameter.
n=0.015 for pipes from 26 to 42 in. in diameter.

Class 2. (Modern "dry-mix" concrete pipe and monolithic concrete pipe or tunnel linings made over rough wood forms.) n=0.013 for pipes up to 36 in. in diameter.

Class 3. (Small "wet-mix" pipe in short units; "dry-mix" pipes in long units; average monolithic pipe made on steel forms.) n=0.012 for pipes up to 24 in. in diameter.
n=0.013 for pipes more than 24 in. in diameter.

Class 4. (Glazed—interior pipe lines; monolithic pipe lines where all interior surface irregularities are removed—only highest grade of workmanship and materials.) n=0.011 for pipes from 12 to 24 in. in diameter.
n=0.0115 for pipes from 26 to 28 in. in diameter.
n=0.012 for pipes more than 50 in. in diameter.

Comparisons Between Concrete and Corrugated Metal Pipe

It will be noted that the coefficient of roughness increases with the increases in diameter of both concrete and corrugated metal pipe. For the purpose of making a comparison, however, this slight variattion has been neglected. In order to compare the carrying capacities Table I has been prepared showing the capacity of various sizes of pipe. For concrete pipe a value of "n"=0.013 is used, because the character of workmanship and finish of a culvertt is not generally of as high a grade as in sewer construction. Reference to the above table of values, suggested in Bureau of Public Roads Bulletin 852, will indicate that this value of "n" gives a proper factor of safety. For corrugated metal pipe a value of n=0.021 is used. The pipes are figured as flowing full. The entrance and velocity losses are disregarded as they are practically the same for each material with a given type of entrance.

Similiar computations were made for pipe culverts of the same materials on different gradients and show that the percentage of comparative capacity is independent of the gradient. The practical application of these data in highway construction is apparent. It can be seen readily that a 12 in. concrete pipe can be substituted for the 15 in. corrugated metal pipe, a 15 in. concrete pipe for an 18 in. corrugated metal pipe, an 18 in. concrete pipe for a 15 in. corrugated metal pipe, the substitutions continuing in the same proportion as the diameter of the pipe increases.

TERRE HAUTE MEMORIAL STADIUM

By George J. Stoner, Vice President and Secretary, Shourds-Stoner Co., Architects and Engineers, Terre Haute and Chicago.

The Terre Haute Memorial Stadium, now in course of construction is being erected by the Board of Park Commissioners of the City of Terre Haute, Indiana, in Stadium Park, formerly the old County Fair Grounds, which is located at the Eastern edge of the City on Wabash Avenue, which is the principal business thoroughfare of the city and which is also on the National Highway.

Terre Haute has long felt the need of an adequately housed athletic field. This was brought especially to the attention of the Park Board last year when the Terre Haute Base Ball Club won the

Three-I League pennant for the first time in twenty years. The ball park used by the Three-I League team has an old-fashioned wooden grand stand and bleachers into which it is almost impossible to crowd over 4,000 people, and last year on Sundays and holidays the grand stands were completely filled an hour before time for the game to start.

Also the high school athletics of the city draw large crowds, especially the Thanksgiving Day football game between the two largest high schools which is an annual affair attracting the interest of practically the whole citizenship.

In addition to this Terre Haute has two colleges, Rose Polytechnic Institute and the Indiana State Normal which have in the past not had adequate seating capacity for the crowds at their big games.

There is also held annually various exhibitions such as the auto shows, pageant of progress and other manufacturing and agricultural exhibitions which were necessarily held around at various inadequate places because of the lack of a real community building or structure designed for these purposes.

In addition to all of this the citizens of Terre Haute felt that a memorial of some kind in memory of the men and women who served in the world war should be erected. So the Board of Park Commissioners, consisting of the Mayor of the City, the Honorable Ora D. Davis; Mr. Wood Posey, president; Mrs. Conrad Herber, secretary; Mr. Wm. Cronin and Mr. Carl Bauermeister conceived the idea of a municipally-owned memorial stadium which would be the home of professional baseball, boxing, etc., and also be arranged for football, track, tennis and other sports; which would have ample space for fairs and exhibitions and which would comfortably seat any crowd which a city of this size would draw and at the same time serve a fitting memorial to the heroes, both living and dead, who have served the country in the army, navy and marines.

The site is a beautiful wooded area of 55 acres of which the stadium structure itself will occupy 13 acres. This tract has been owned by the county for over a hundred years and it was upon this site that the famous old Terre Haute mile track was located which was the scene of many a thrilling race in the olden days.

The Park Board purchased the site a few years ago from the county for a city park and when the question arose as to the location of the stadium it was the unanimous opinion that this was the ideal place.

The structure itself will be nearly entirely of reinforced concrete construction. The only exception being the main entrance arch which will be built of gray Indiana limestone and the columns and trusses supporting the roof which will be of structural steel. It consists of 21 complete sections; there being expansion joints provided every 64 ft. traversing the complete section of the stand.

The main memorial entrance resembles in design an imposing triumphal arch and will contain inscribed on bronze tablets the name of every man and woman from Terre Haute and Vigo County who rendered service in the war with Germany and Austria.

The structure is unique in that it is the only stadium so far designed to act as a permanent home for the two major sports of football and baseball. In other words, it is a combination design of the usual college or university structure designed primarily for football and of the professional baseball league park of the larger cities.

In addition a full one-quarter mile running track with a 220-yd. straightaway is included in the playing field, and the part of the structure underneath the seat banks will be finished off and will form an ideal place for the holding of the various exhibitions desired, such as farm exhibitions, mercantile displays, auto shows and other city and county activities.

The huge horse shoe shaped stadium structure lies on an axis extending in a northeasterly and southwesterly direction ending in the imposing main entrance memorial arch which faces the southwest corner of the tract but which lies well back in the beautiful wooded park about 500 ft. from the National Highway and will present a striking appearance to the thousands of motor tourists who annually travel this trans-continental highway.

The open end of the horse shoe faces the main line of the St. Louis Division of the Pennsylvania Railroad system, a main traffic artery between the Atlantic seaboard and the central and far west.

The seating capacity is 20,000; arranged for 30 rows of seats topped with a wide promenade extending around the entire horse shoe and with numerous entrance and exit ramps so that the entire stands may be emptied in a very few minutes.

The line of vision of each row of seats

was carefully laid out so that every angle of the entire field is clearly visible from each and every seat.

An idea of the size of the stands will be gained from the fact that the outside wall is over one-quarter mile in length.

A complete roof covers 8,000 seats approximately 1,000 of which are box seats. This provides for the baseball crowd where cover is desirable. All the seats are of wooden construction on top of the concrete. The ones under the roof have backs and all of them are designed for comfort. The most desirable seats for football are not covered as it is generally more satisfactory for this sport to be entirely out in the open. These football seats form the so-called bleacher seats for the baseball diamond.

The baseball field itself is larger than that of any baseball park in the major leagues, except one and the standard football gridiron has seats entirely along each side and around one end.

Boulevard lighting standards extend completely around the promenade. A complete lighting system including flood lights provide for night as well as day time events.

Particular attention has been paid in the design to secure adequate toilet and rest room facilities for both men and women. Also the highest class shower, locker, first aid and team rooms have been provided for each of the contesting teams.

The exhibition space underneath contains over 225 exhibit spaces 16 ft. square amply lighted for daylight use and provided with electric outlets for night use.

A feature of the layout is that entrances to the field from the outside sufficient to admit the largest vehicle or float are provided so that parades or large spectacles such as circuses may be accommodated in the enclosure if desired. Special boxes have been provided for the use of notables who may be the guests of the city.

It is thought that the stadium will be entirely self-supporting from a financial standpoint as well as a very desirable acquisition to the city from a recreational and civic point of view.

The Shourds-Stoner Company of Terre Haute and Chicago were selected as architects and engineers by the Park Board and made a careful study of the existing college, municipal and professional structures of similar nature throughout the country before completing the design. The plans for the stadium and the playing field have been carefully inspected by some of the best known college and university athletic directors who pronounce it all that could be desired in a structure of this type.

The total cost complete will be in the neighborhood of one-half million dollars.

The North Raffin Construction Co. of Terre Haute are the general contractors; Prox and Burget of Terre Haute, plumbing contractors, and the Sanborn Electric Co. of Indianapolis, electrical contractors.

QUESTION RAISED AS TO COST AND VALUE OF POWER AVAILABLE IN PROJECTED ST. LAWRENCE CANAL

(Editor's Note: This magazine strongly favors any proper method of giving ocean-going steamships direct access to the ports on the Great Lakes and has had a sympathetic interest in the St. Lawrence seaway. But, first of all, we favor sound promotion of great projects and the following article deserves consideration because of its discussion of the value, as compared wth the cost, of the power that may be made available in the United States if this project is carried out. Discussion of the assumptions, assertions and conclusions of the article is invited. The article was published by the Buffalo, N. Y., Chamber of Commerce. A subscriber in Buffalo has suggested that it be given the benefit of the wider publicity it receives by its publication here).

There is one statement made uniformly by all advocates of the proposed St. Lawrence Ship Canal which has not been given the attention in the discussion that its importance merits. Broadly stated, it is to this effect:

"No matter what the initial cost of the canal may be, the revenue from power development of the river will furnish ample funds to pay for it."

But no suggestion is offered that any tolls will be charged against the commerce using the canal or that they might be sufficient to pay for that part of the project. Whenever the economic soundness of the canal is questioned, the answer always is that the power users will foot the bill.

It is obvious that this power might be produced without making the river navigable and that the cost of such a power development would be much less than the total cost of the whole canal project with all the additions of locks, canals, dredging, docks and other accessories. So it is

pertinent to inquire how much power there is, to whom it belongs and who the unfortunate users may be who are to be assessed for the cost of a canal that others want to use without cost to themselves.

Available Power

In round figures there is possible in the St. Lawrence between Lake Ontario and Montreal the commercial development of four million horse-power, but of this only about one and one-half million is located on international waters; the other two and a half million being entirely within the Canadian boundary. The report of the joint commission recommends that each country shall pay for the "power works" within its own boundaries so that Canada will own about three and one-quarter million horse-power while the United States will have only three-quarters of a million. But the report also states that since a market will have to be developed for the use of this amount of power, the present plan contemplates only the production of the one and a half million on the boundary, half of which belongs to the United States. So that it is really our small share of 750 thousand horse-power toward which our enthusiastic canal advocates are looking as a source of revenue to "pay the bill."

What will be the amount of this bill? The total cost, according to the report, is a sum slightly in excess of 250 million dollars, but this does not include the cost of improving the Welland Canal which is exceeding its original estimate of 50 million dollars, and which is to be included as a part of the cost of the "navigation works" toward which the United States is to contribute its share. And be it noted that our share is not one-half as might be expected, but is such a proportion of the total as our anticipated use of the canal will bear to that of Canada which, according to the report, will be large although no definite figures are given.

So it appears that "the bill" that is accruing against our power users is likely to be about ¾ of the navigation cost of both the Welland and St. Lawrence canals added to the legitimate cost of the power development alone.

Division of Cost

To discuss this matter intelligently, the total cost should properly be divided into three parts as follows:

A. The cost of those features that would be of common use both to power production and to navigation, such as dams.

B. The cost of those features that would be exclusively needed for power development, such as power houses and machinery.

C. The cost of those features that would be exclusively needed for navigation, such as locks, canals and dredging.

The engineer's report does not give the costs of these elements separately, because it is based on the assumption that the canal is of primary importance and power development is a by-product, but a careful analysis of the detailed estimates shows the following division of costs for the three indicated groups as nearly as they can be determined from the description of the items.

A.	$33,487,620
B.	70,776,360
C.	154,489,790
	$258,753,770

In order to allocate the total cost between navigation and power, it would be fair to divide the cost of A equally between these two features of the project which would give the following relative costs of each:

	Navigation	Power
A divided equally	$16,743,810	$16,743,810
B power only		70,776,360
C Navigation only	154,489,790	
	$171,233,600	
Welland Canal, over	50,000,000	
	$221,233,600	$87,520,170

It may be argued that if the power were developed alone, it would have to carry all of the cost of Item A, so that in making a comparison, navigation should only be charged with the additional cost of its features. This would work out the relative costs as follows:

	Navigation	Power
A		$33,487,620
B		70,776,360
C	$154,489,790	
Welland Canal	50,000,000	
	$204,487,790	$104,263,980

The contribution of the United States, assuming that our commerce on the canal is three times that of Canada, would then be in the first case,

¾ of $221,000,000	$165,750,000
½ of 88,000,000	44,000,000
	$209,750,000

Or if the second arrangement were conceded,

¾ of $204,000,000	$153,000,000
½ of 104,000,000	52,000,000
	$205,000,000

In either case, the amount of capital cost for the canal which the power user is to pay for is three times as large as the cost of the power development alone, so that his price for power will carry four times the capital charges that it should.

On the other hand, the Canadian power user will get his ¾ of a million horse-power for a capital charge of half this amount, so that he can export it to us at a handsome profit from this item alone. Nor is that all, because there remains 2½ million more horse-power in the lower river which Canada can develop for an additional sum of $200,000,000, which they can sell to us still more profitably in competition with the exaggerated rate set upon our share of the power in this manner.

For Independent Financing of Navigation and Power Features

In all fairness then, the canal and the power should be financed independently, so that each may be considered on its own merits as a commercial venture. The question of the expediency of the canal project then resolves itself into the question as to whether tolls can be collected from the use of the canal to pay for two-thirds of the total cost of the whole development, and the figures of probable tonnage so far adduced do not offer much encouragement to such a belief. In fact, the very circumstance that the proponents of the project suggest cheerfully loading the entire cost onto the power end indicates pretty clearly that they have no confidence in the economic soundness of this aspect of the scheme.

But it happens that this proposed injustice has a much wider application, because the ¾ million horse-power is a large enough block to exercise a modifying influence on the base price of power throughout the super-power zone. Consequently, if the price of St. Lawrence power is set several times higher than it should be in order to pay for the cost of the whole navigation part of the project, the effect will be felt by every power user east of the Alleghanys, from Niagara Falls to Richmond, and will be reflected in the cost of half of the manufactured goods of the country since that area comprises at least that proportion of the industrial activity of the nation. This point has not been clearly brought home either to the residents of this vast area or to the nation-wide consumer of the goods produced within its limits, else there would be much more active interest in the controversy on the part of the large mass of population who will ultimately have to pay the bill, not through taxes, but in power and light rates forever.

POLITICAL VS. NON-POLITICAL WATER WORKS MANAGEMENT

By R. E. McDonnell of Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo.

There is nothing about the operation or management of a water works plant that justifies any less degree of business sense or judgment than would be demanded of the highest type of business institution.

Because a water plant is owned by the city and the citizens are stockholders is no excuse for ignoring the policy, rules and regulations that apply to any other business institution. Why should political conditions be applied to selling a commodity like water when we know they cannot be applied to selling coal, bread, butter or any other commodity?

How long would our leading merchants, bankers, or manufacturers stay in business if they said to their heads of departments: "Your ability is a secondary consideration, but you must put on our payrolls loyal Democrats or Republicans, put on our friends who helped at election day, put on men who are good ward workers, men who can poll a precinct." Such a policy if applied to any business, except city business, would cause bankruptcy in thirty days.

Why doesn't it cause bankruptcy of a city? Because the citizen stockholders are called upon, by increasing taxes, to take care of increasing deficits.

We are paying the penalty for the curse of partisan politics in city affairs. What a price we are paying because of our classifying ourselves as Democrats and Republicans!

This damnable burden of partisanship hangs like a stone about the neck of many cities. It is a blight more deadly than an epidemic for if it were an epidemic, steps would immediately be taken to remedy the cause.

Community health is the city government's greatest responsibility and it must be protected from petty politics. The purity of a water supply is always an index to the health of a community. The doctors' bills, nurses' bills, hospital bills and drug bills you pay out are a loss to you, but all are necessary because politics cannot give the best of skill for handling those water and health problems.

Water above all other things is the one problem having the greatest bearing upon the health, safety and prosperity of its citizens. Sixty-five per cent of all typhoid is attributed to impure water.

Instead of water improvements preceding the growth of a city they have often lagged behind the general growth and as a result cities will frequently face serious water shortage and many breakdowns before new works can be built.

It may be asked why a political board cannot do the things that ought to be done. There are many reasons:

(1) The water board changes with every administration and these frequent changes prevent any permanent program being adopted. It substitutes a haphazard policy that pleases the powers-that-be.

(2) An engineer ever so efficient and familiar with the operation of the plant is frequently displaced to make room for a friend of the Mayor or of the Board, or of a political boss and the public suffers by such changes.

(3) Even if the political board is made up of the highest type of men, they owe their appointment to the Mayor, and he owes his election to the bosses and, therefore, politics and not ability govern their appointments.

(4) Political jobs where the tenure of office depends upon the vicissitudes of political life, do not attract the high class technical men required for water works construction and operation.

(5) Salaries commensurate with the work and responsibility of technically-trained men cannot be paid by political boards, for fear of criticism. For example, the politicians of San Francisco have been wailing for three years because the Chief Engineer of the Water Department is paid $15,000 per year, a salary higher than the Mayor receives. At Omaha, a city where the Water Department has for ten years been out of politics, the manager is paid $10,000 per year and is worth many times that to the city.

(6) Regardless of the Board's intentions and those of the Mayor, they cannot ignore the organization that placed them there.

A water works plant for any city is valued at about the same or higher value than any of its largest industrial enterprises. This calls for a big broad gauged program; not for two or three years, the life of a political board, but for a lifetime.

Imagine any other business of equal importance in a city that would think of handling its affairs by men selected every two years and because they are right politically. The water question, because of its relation to the health of the community and financial magnitude, demands the biggest brains available and until we do the job commensurate with its importance, some cities will continue to be the laughing stock of other progressive communities.

Frequently business and professional men show a lack of human intelligence when it comes to being led by blind partisanship in city affairs. We go wild every two or four years and follow madly anything with a party label. As long as we continue this we should not complain at paying the price in deficits, in tax increases, in delayed improvements, in high death rates.

FEATURES OF NEW WATER SUPPLY AT PARIS, TEXAS

By John B. Hawley, Consulting Engineer, 403 Cotton Exchange Bldg., Fort Worth, Texas.

Paris, Texas, has a population of somewhere near 20,000. It is a thrifty, prosperous, growing city, surrounded by rich agricultural lands, has five railroads, several maunfacturing plants, and numerous wholesale houses. The streets and alleys are almost universally paved with asphalt of various types; its public buildings are thoroughly modern; its street lighting system is comparable with that of Dallas or Fort Worth. It is not far from the Northeast corner of the State, near the Red River.

ROLLING WETTED EMBANKMENT WITH BANDED ROLLER, PARIS, TEXAS, EARTHEN DAM.

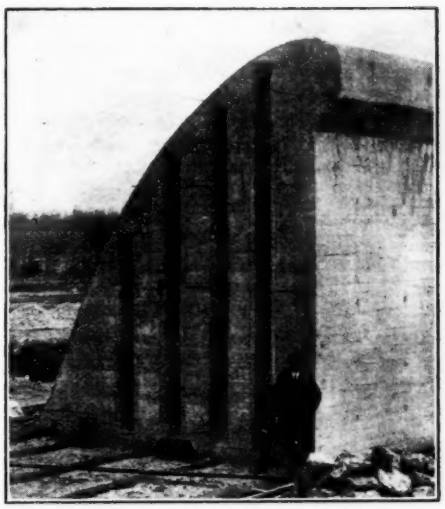
The mean annual rainfall is 38 in, with a minimum of about 18, and maximum of 60 in. Geologically, it lies in the "Eagle Ford Shales," the lowest member of the Upper Cretaceous.

Early in 1920 the writer began a study of water supply matters for Paris, and in the summer called into consultation Mr. Daniel W. Mead, of Madison, Wis., who joined in a report recommending Pine Creek, a tributary of Red River, as the future source of supply. An earthen dam, about 30 ft. high, 3,200 ft. in length, to impound and store the water of Pine Creek, was recommended.

The report outlined also a pumping and filtration plant at the South end of the dam, and a 20 in. cast iron supply main, 4½ miles in length, carrying filtered water to a 500,000 gal. elevated tank near the center of the City. The water level of the tank is 135 ft. above its foundations.

The estimated cost of the entire project, including purchase of inundated lands, was $1,000,000. Upon this estimate, the citizens (almost unanimously) voted a one million dollar bond issue in September 1920.

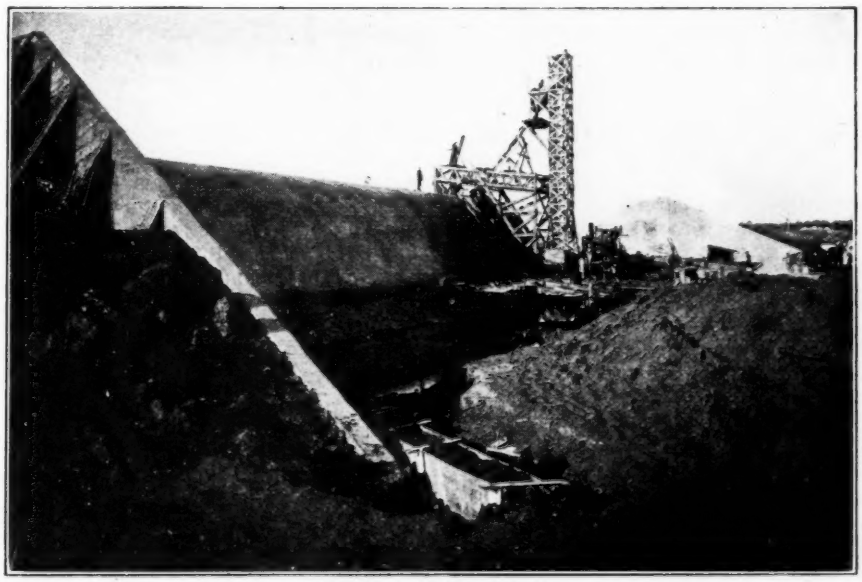
As the bond market was greatly depressed for more than a year after this, the Mayor and City Council wisely deferred sale until January 1922, when the bonds were sold for par and accured interest. During this "waiting" interval the cost of materials and labor had greatly declined.



END VIEW OF SPILLWAY SECTION, PARIS, TEXAS, DAM.

Plans for all features of the work were developed by the writer, concurred in by Mr. Mead, and construction contracts were awarded in May 1922. The entire works were finished in April, 1923, in time to catch the "Spring rises" of Pine Creek, filling the Lake. Four miles up Pine valley the old "City Lake" impounds about 1,000,000,000 gals. City Lake was nearly empty when the new dam was completed and the new lake filled.

The drainage area of Pine Creek, above the new dam, is approximately 50 square



DOWN STREAM SIDE OF SPILLWAY SECTION, PARIS, TEXAS, DAM.

miles. The capacity of lake, all available is 4,000,000,000 U. S. gals. Computation of run off, evaporation, seepage and daily consumption demand, indicate that the two lakes will supply a population of 35,000, at 80 gals. per capita per day, even through a period of six drought years such as 1896 to 1901. The City is 100 percent metered.

The earth section of dam was laid up in 1 ft. horizontal layers, (loose) thoroughly wetted, (about 15 gals. of water per cubic yard) rolled and rerolled with a banded roller that gave compression of 400 lbs. per lin. in. of rear wheels. The material was largely of clayey nature, debris of the Eagle Ford Shales and Blossom Sands.

The water face of the dam was trimmed by removing 1 ft. of "frazzle," perpendicular to slopes, by pick and shovel, laying the reinforceed concrete flags, which are 5 in. thick, constructed "in alternate." The toe of flags abuts on a heavy concrete "footer" for which a 6-ft. horizontal berm was provided.

The photos pretty well illustrate the concrete spillway section and cantilever abutments. The water way is 300 ft. wide and 10 ft. depth.

(These dimensions seem, at first glance, excessive, but were adopted only after long study by Mr. Mead and the writer. See "Public Works" Nov. 13, 1920.) The spillway section and abutments are carried on piling.

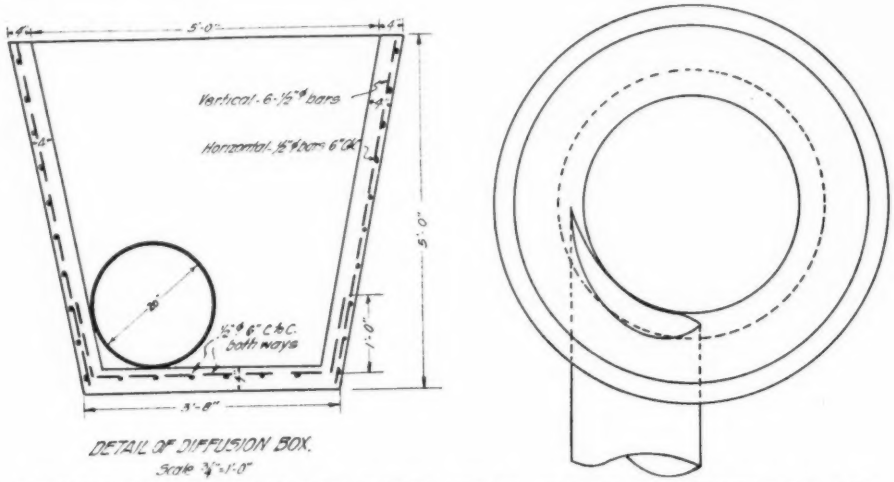
The pumping plant comprises three units: One two stage centrifugal, 1050 gals. per minute at 305 ft. dynamic head; one to two stage, 1,400 gals. per minute at 310 ft., both electrically operated and one two stage, 2,000 gals, per minute, at 325 ft. dynamic head, operated by Sterling gasoline engine, as "standby." All pumps have individual, independent suction pipes to clear well, and independent discharge pipes to supply main, which is equipped with recording Venturi meter. Allis Chalmers pumps and motors were used.

The filtration plant is of 3,000,000 gals. daily capacity, four beds of 750,000 gals. each, three of which are fully equipped and the fourth "roughed in," ready for full installation when needed.

Raw water enters the mixing chambers by gravity, receiving the alum dose at a point near the pumphouse end of the building. The dosed water is given its first diffusion by the "whirl" developed in the inverted truncated cone shown at head of mixing channels, and in the line drawing. The 20-in. raw water pipe enters the bottom of this cone eccentrically. The mixing channels have a length of 1,000 ft.

The filtration plant is of conventional type as a whole, but the well lighted pipe gallery, open to the pump floor, is rather unusual. The circular 400,000 gal. clear well lies to the North of building, and is independent of the latter. Maximum daily pumpage during the summer of 1923 has been 1,200,000 gals.

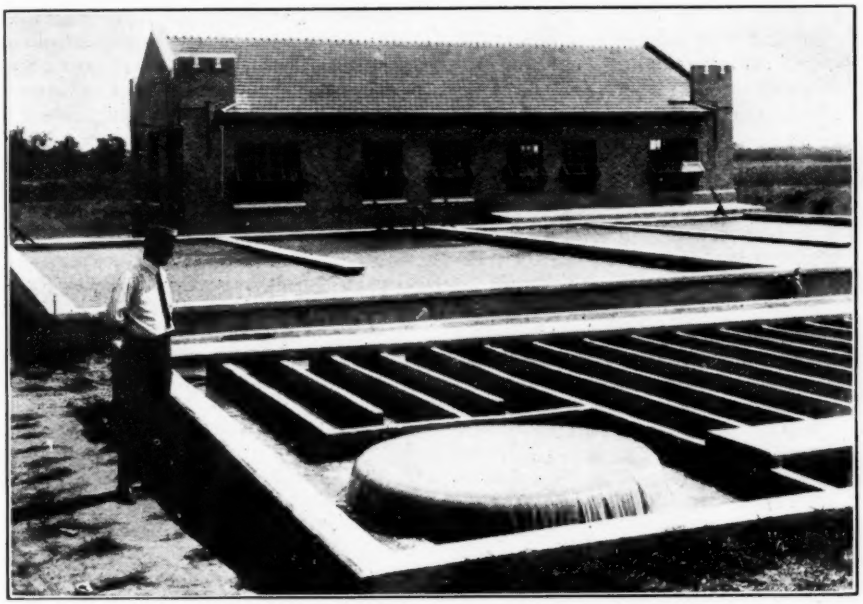
Under these conditions the labor cost is at a minimum, the lone operative, Mr. Baker, handling both filtration and pumping plant, under the direction of Mr. M. C.



DETAILS OF DIFFUSION BOX, PARIS, TEXAS, WATER SEDIMENTATION AND FILTRATION PLANT.

Welborn, Assoc. M. Am. Soc. C. E., City Engineer and Superintendent of Water Works.

The filtered product is tested daily, chemically and bacteriologically, by Mr. Welborn. Algae troubles occured in July, but were quickly abated by mildly dosing the lake with cupric sulphate.



DIFFUSION BOX, MIXING CHANNELS, SEDIMENTATION BASINS, AND FILTER AND PUMP BUILDING OF NEW WATER SUPPLY WORKS AT PARIS, TEXAS.

The entire improvement, including all engineering expenses, cost approximately $800,000, leaving the remainder of bond money for city extensions. City Engineer Welborn had charge of all construction. McGuire and Callender of Kansas City, were the general contractors.

ENGINEERING AND ITS RELATION TO THE COMMUNITY

By Wm. R. Conard, of Conard & Buzby, Consultants and Engineers, Savings Institution Bldg., Burlington, N. J.

The definitions of the words Engineering and Community are given as:

Engineering: The art of designing and superintending the execution of works of a constructive character, such as roads and streets, railroads, bridges, canals, harbors, docks, water works, sewerage works, lighting, power, buildings, and also in the working of metals, and the making of machinery.

Community: Common possession; the body politic; the public; society at large.

At first glance there does not appear to be much in the way of a connection so far as the definitions go between these words so that the task is to establish the relation and of producing sufficient data to prove it.

The conduct or operation of the community functions in at least 7 ways: Organization, co-operation, control, administration, legislation, execution, and regulation, and, by the same token, engineering and the engineer function in the same way at least as the first six.

We have established the relation, and it now becomes necessary to prove that there is an actual connection.

We will take the community functions in the order in which I mention them, and endeavor to show that each is also a function of engineering work.

First, Organization:—The engineer in approaching problems of the community first so organizes his own mind and that of his associates that each phase of the problem stands out by itself and from these in turn are selected the phases of greatest importance then, secondly, thirdly, and so on down the line to minor phases or details.

Second, Co-operation:—After organizing for the problem the next function is to establish the points of contact be-

tween the various phases and then proceed so that each is looking to a common end and the successful solution of the problem as a whole and he thereby gets co-operation.

Third, Control:—After organizing and getting co-operation for the common end, and the complete and successful solution of the problem the function is so to "*control*" the co-operation of the organization that the different phases of the problem advance onward smoothly toward their final answers.

Fourth, Administration; Fifth, Legislation:—These two are so closely allied that the one proves the other. After the answers are found, and the next step in the progress toward the end sought is made, it is necessary to administer the answers and provide the necessary legislation that places the problems on a footing whereby they can be executed.

Sixth, Execution:—The work has been organized, co-operation is obtained, it is being controlled, administering and legislation provided for and the job is now on a proper basis for execution or, to use a more common term, it has reached the active construction stage.

Seventh, Regulation:—After the completion of the job, and it is ready to be turned over from construction to operation it becomes necessary to provide for its careful and regular operation and to that end proper, sane and simple rules of regulation should be adopted, and if these are adhered to there remains no reason why it will not continue to operate with regularity and efficiency.

So much for engineering and now the community.

A community as we understand it today consists in its physical aspects wholly of those things defined as engineering, such as, buildings, roads, streets, water works, sewerage works, lighting, water ways with harbors, docks, canals and bridges, together with such machinery as will construct and operate the various parts that make the whole; in addition to which there must be means of communication either between parts of the community itself and with other communities which naturally makes use of the term railroad or railway, so that almost wholly is any community dependent upon the proper solution of the problems of engineering.

The community also has its problems, of finance, taxation, policing (which is the sane control of its citizenry) legislation, execution of city policies, and co-operation of its people when properly organized. But I submit that by his very training and methods of functioning the engineer is as well qualified to control, administer, legislate, execute and regulate, as any other citizen, and in many instances more efficient than others.

It is because of the close relation of engineering and the community that in the very large majority of cases where our American cities and towns have adopted and are operating under the so-called "Manager" plan of government that the manager is an engineer, for his very training has taught him to: Organize, co-operate, control, administer, legislate, execute and regulate.

THE ARTERIES OF COMMERCE

"More movement, less storage and a better organization of off-rail movement of railroad tonnage," was declared by Mr. J. Rowland Bibbins, engineer and transportation specialist, Washington, D. C., to be the great step in efficiency of the present time, in addressing the recent Chicago Convention of the American Society of Civil Engineers on "The Arteries of Commerce."

What the railroads need is a vacuum pump to pull the freight away from and clear the terminals more promptly and shorten the turn-around of car, ship and truck. This will be the greatest capital saver of the future and simply recognizes that transportation must be considered a through movement, both off and on-rail. It will require a better realization by truckers and industries that railroads have spent probably 50 cts. out of every dollar on other than main line facilities, i. e., on terminals, the "heart" of the system. But the "capillaries" or off-rail distributory system is equally important and the operating costs to the American people are probably as much per year as the total cost of the rail haul. The motor industry has a large problem of organization here in serving both the public and the railroads.

"Growth in values of terminal lands offers perhaps the most hopeful outlook in the development of the near future," said Mr. Bibbins, because of the probability of reclaiming the full values of their lands either by the development of "air-rights" above the tracks for normal business purposes or else by full commercial development, setting back the

terminals to cheaper land areas and using motor-truck delivery. This constitutes a practically unused resource of the railroads in our large cities and will be a two-fold benefit where, as in many cities, railroad terminals are seriously throttling normal expansion of the business center. In fact there seems no other way out of this particular city problem.

Mr. Bibbins presented technical studies of transportation growth since the Civil War, which shows clearly that traffic has increased about as the cube of the population, while fixed physical facilities are probably not increasing even in numerical proportion. This means that the problem of transit through terminals will progressively increase in difficulty unless the "vacuum pump" of speedier motor delivery is applied. His studies indicate that a traffic of four billion revenue tons may be expected by 1940, i. e., a 60 per cent increase, also at least 10 billions new capital for railroads alone if developed on the present system.

But the most striking development pointed out by Mr. Bibbins was that our national transportation plant—rail, water, road, trolley—has cost around 50 billions to date with almost as much—nearly 20 billions—expended for highways and highway transport as for railroads and that in the last decade this new agency has commanded four times as much new capital as railroads. Moreover, if road, water and electric facilities grow only as fast as the railroads, 15 billions more will be required by 1940, or 25 billions total for all transportation. The problem of fitting all these agencies into the whole scheme most efficiently is thus a paramount one before the country.

Another great neglected resource of the railroads was stated to be the joint development of the very valuable entrance rights-of-way into our cities for rapid transit lines and for motor ways in order to save the tremendous costs of parallel right-of-way in subways and trucking thoroughfares which few cities can finance or support.

The necessary difficulties of transport operations in large cities and gateways point definitely, Mr. Bibbins declares, to the great need of proper study and planning for the future as well as the present. And this is a distinctly new development of the wide-spread City Planning movement in which transportation men should be heard. Here is the "heart" of the whole machine, the most sensitive point of control of the life blood of commerce, and every populous community should have a definite transportation plan to guide its future development. The terminals—rail, water, motor and transit—are from the public standpoint all interlinked, and together with the thoroughfare system of the city, constitute the starting point in most effective control of a city's destiny. This has very generally been overlooked in the past and left almost entirely to the whim of competing transport systems. But the tremendous demand of future commerce must and will bring about a change—which may rival even the vastly important matters of consolidation and rates, just now in the ascendancy.

MINNESOTA ENGINEERS IN PUBLIC AFFAIRS

The participation of engineers in public affairs of Minnesota has been a very potent factor in the development of the State, but this participation has generally been limited to promotional work by society groups, for the purpose of bringing about new legislation affecting only engineering projects. In this respect the engineers of the State have been very successful, as may be evidenced by the progress brought about in State laws relating to highways, drainage, sanitation and contracting, and in city ordinances governing city planning, building codes and structural inspection, for all of which the engineering societies have due credit, and it may truthfully be said that they have been primarily responsible for a considerable part of this development.

Until just recently, however, this original work had not been followed up. It has been customary, after the enactment of new engineering policies into law or ordinance and the first flush of enthusiasm has waned, to leave the further necessary legislation and public support to be promoted by those engineers directly affected. Herein lies the opportunity for service by the engineering fraternity as a whole in its relation to public affairs.

It should be a matter of professional principle for all engineers to be well informed on public matters affecting general engineering work and to exert some effort to direct the forming of public sentiment and opinion which really governs administrative policies and legislation. This seems to be the only way to make progress under present conditions for en-

gineers are not generally represented in legislative bodies. The last Minnesota legislature had but one engineer out of a total membership of two hundred, and there was none in the previous season. Very seldom is an engineer to be found in a City Council, and until the engineers do take active interest in political matters we cannot hope for the best results in public work.

Within the last few years there has been a marked development in this State in the participation of engineers in public affairs through the organization of the Minnesota Federation of Architectural and Engineering Societies. This federation of technical organizations can become of great value and service to the community but only through the active help of the individual members. Its Board of Directors has given freely of time and effort successfully to promote and develop public policies affecting engineers' work. We cannot, however, expect the Directors to carry this entire burden but must develop in the individual a consciousness of responsibility for the support of those things which are important to engineers as a whole, even though some such matters have no connection with or bearing on the work of the particular individual in question. The tendency, we find, is to leave too much of this work to our committees and directors; becoming so much engrossed in the details of our own activities that the broader development of engineering practice and influence is retarded through lack of support.

One of the judges of our Supreme Court in a public address recently stated that of the evidence brought out in litigation, that which was offered by engineers was given greater credence than perhaps from any other source as it is recognized that the engineer's testimony and opinion are based upon a careful investigation of facts and a logical application of scientific principles. This statement coming from one who has been on the bench for more than 15 years is food for thought and is an indication of the force which may be exerted by the engineers through concerted well directed effort in matters of public policies. Engineers should not shirk their responsibility through a false idea that politics is not for the professional man. Politics is the science of civil government and would be much the better for the participation in it by engineers.

The foregoing is from a recent address by Mr. John H. Mullen before the Engineers' Society of St. Paul.

VALUABLE TRADE LITERATURE

Electrical Supply Catalog—The Westinghouse Supply Catalog, generally regarded as an encyclopaedia of things electrical is now being distributed. This issue for 1923-24 replaces and supercedes all catalogs issued heretofore on electrical supplies by the Company. In appearance the new catalog does not differ greatly from its predecessor. The former editions have proved so useful and satisfactory that no essential features were altered, the improvements being largely a matter of detail and refinement. Appreciating the importance of accessibility to the specific information wanted, the utmost care was used to meet this requisite. The catalog is indexed according to subjects and to sections, and also has a style number and a thumb index. In addition, a new feature—a classified index—has been added to the introductory section under the title, "How this catalog serves." Here is listed apparatus of particular interest to Central Stations, Electric Railways, Industrial Plants, Mines, Contractor-Dealers, and Architects. The catalog announces the opening of a new plant at Homewood, Pa., which will be devoted exclusively to the manufacture of repairs and renewal parts for Westinghouse apparatus in service but of design no longer strictly standard. A complete list of all Westinghouse Sales offices, Agent Jobbers Warehouses, Service Repair Shops is also given, together with several illustrations of new combination sales, service and warehouse buildings either recently built or now in course of construction. In all, 1,300 pages are devoted to descriptive matter, technical data, dimension drawings, specifications and prices. The material includes all new apparatus developed in the last two years. The street lighting section probably shows the greatest revisions and over 175 pages are devoted to this feature. Close observation shows that the new issue presents a wider variety of apparatus than any catalog heretofore issued by the Company. All sections have been completely revised and some rearranged, which greatly facilitates the ordering of equipment.

Construction News and Equipment

CONSTRUCTING MONOLITHIC CULVERTS IN NORTH CAROLINA TIDEWATER SWAMPS

By I. H. Boggs and C. L. Tindall, Resident Engineers, North Carolina Highway Commission, Raleigh, N. C.

Portions of Projects No. 200 and 201 in Carteret County, N. C., cross tidewater swamps where bridges are unnecessary and where the flow can be accommodated by large culverts. The water in these swamps is salt; consequently, it was thought advisable to build monolithic culverts.

For a long time it has been an accepted fact that salt water is detrimental to concrete. No method of construction nor consistency of mix has yet been found that is guaranteed to competely withstand salt water. It is believed, however, that dense concrete and few if any construction joints will go a long way toward making concrete impervious.

Eleven culverts on the above named projects are under construction in salt marshes. By a special order from the Bridge Department, these culverts are being constructed of Class "A-A" concrete (1:1½:3 mix) and are being poured as a monolithic structure.

The usual way of pouring a concrete culvert—footing first and barrel and headwalls after the footing has set up—is generally known. The monolithic culvert is rather uncommon and the mode of construction may be noted with interest. The general scheme of construction that is employed by the contractor on Projects No. 200 and No. 201 for building monolithic culverts is a combination of ideas of all concerned as no one on either project had ever seen a monolithic culvert built.

Unfortunately, there is not a stable foundation in any of the salt marshes. First, therefore, it is necessary to drive bearing piles to carry the load. Incidentally, these piles are of great assistance in the construction of a timber floor which has to be built under the entire footing of all the culverts.

The footing of an ordinary culvert, where conditions demand, may be floored with pine slabs or other cheap lumber, then the footing poured and allowed to set up before the rest of the structure is completed. The footings of these monolithic culverts, however, must be floored with timber of sufficient bearing capacity to support the weight of the entire structure until the concrete sets up and the load is transferred directly on the piles.

After the piles are driven, the excavation is shaped up and carried to an extra depth of about 8 ins. to admit the floor stringers which are spiked to the piles. The floor is built with rough timbers the size of which varies with the span of the culvert. The floor under the barrel is made sufficiently wide to permit the sidewall forms to rest on it.

The entire set of forms for the culvert is built in place on the floor. The outside forms for the wall are braced to poles that are driven securely in the mud 8 or 10 ft. from the structure. The inside or box form is built in sections and then set on the floor and bolted together on the inside. The box form is supported above the floor a distance equal to the thickness of the floor-slab by 1x2-in. strips that are nailed to the studding inside the form. (When the box form is removed from the completed culvert, these 1x2-in. strips are knocked loose from the studding and cut off flush with the floor-slab.) Planks for the top of the box, or that part which supports the top-slab of the culvert, are cut and fitted but not put in place until the footing and half the wall have been poured. Access to the footing while the concrete is being poured is thus permitted.

The steel for the footing is wired together in mats and laid on the floor before the barrel form is set in. It is supported in its proper position by being laid on precast concrete blocks or suspended by wires from the stringers in the box form. This steel is best supported by the concrete blocks. The blocks become completely imbedded in concrete, whereas, wire can be cut off only at the surface of the slab thus permitting an attack for salt water.

Steel for the top slab is wired together,

usually in two mats, and laid in the wet concrete after a 3-in. layer has been poured on the top of the box.

Suspension of the steel in the walls offers no particular difficulty if the brace-wires running through the walls are so placed that they coincide with the horizontal steel. The horizontal steel may be fastened to the brace-wires and the vertical steel in turn fastened to the horizontal.

After the forms are completed and the steel is in place, the greater part of the job is done. Pouring the concrete is comparatively simple and means nothing more than a good, long day's work. With ample material at the mixer, a good supply of fresh water, and an early morning start, an 8x4-ft. culvert is completed in twelve hours with a one-bag mixer. In cool or moderately, warm weather the footing may be poured throughout the entire length of the culvert before a layer in the walls is started, but, if the weather is hot, care must be taken to add a shallow layer of concrete in the walls as the footing progresses. If this layer is not added, the first concrete poured in the footing will have obtained its initial set before the footing is completed and the wall started.

Rubbing of exposed surfaces to remove board marks left by the forms is not permitted. It is believed that concrete is more impervious when the surface is not disturbed by rubbing. A good finish is obtained by first oiling the forms well before the concrete is poured and then tapping the forms lightly with a hammer as the concrete is placed to assure a film of mortar next to the forms.

It may be said that monolithic culverts are no more difficult to build than ordinary culverts. They are more expensive, however, because of the necessity of building a strong timber floor, the extra work in suspending the steel and numerous other extra details.

Great care in every detail is being maintained in the culverts. Only time will tell whether or not monolithic construction is going to lengthen the life of these structures in salt water.

The foregoing description is from the North Carolina Highway Bulletin.

OLD AND NEW TRAFFIC COUNTS ON BROADWAY COMPARED

To the Editor:

Your note, in the issue of June, 1923, quoting figures of traffic on Broadway at Chambers Street in 1852 is very interesting when compared with recent traffic counts. The figures quoted give a total of 15,648 vehicles for 13 hours.

Police records give 10,300 vehicles passing Broadway and Fulton Street in 1915 and 9,565 in 1919, during the 10 hours from 8:30 a. m. to 6:30 p. m. These include east and west, as well as north and south traffic, but do not include street cars.

Correcting the figures of 1852 traffic to a 10-hour day would give 12,040 vehicles, still considerably more than the present-day traffic.

The traffic on Broadway at Fulton Street, a few blocks south, would be in 1852, and is now, practically the same as at Chambers Street.

R. A. MacGREGOR,
Member Am. Soc. C. E., 1709 Popham Ave., New York, N. Y.

STEADY PAVING BRICK PRODUCTION

Continued steady production of vitrified paving brick indicates a healthy business condition in the industry, and continued active brick street and road construction work during the balance of the season.

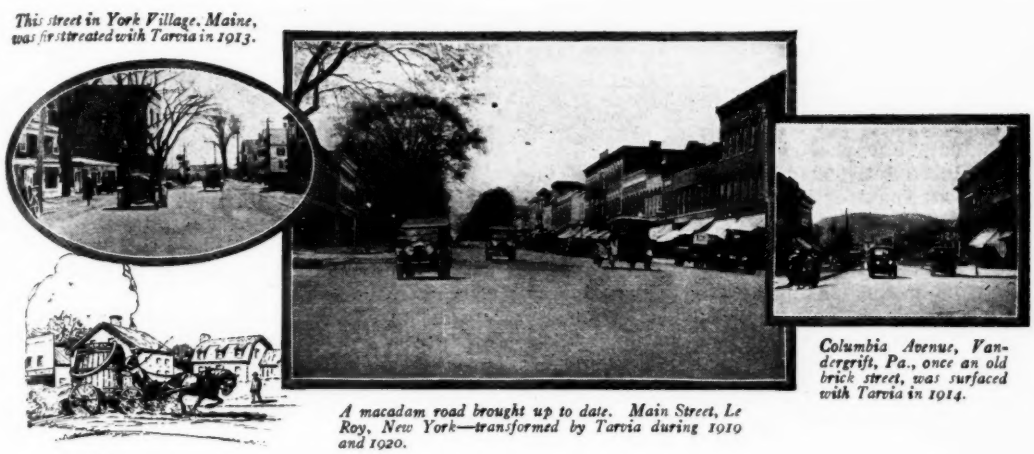
The July statistical report covering 68 percent of the normal tonnage capacity of the industry, just issued by the National Paving Brick Manufacturers' Association, shows production and shipments keeping pace with those of previous months.

Production for July was 30,529,000 and shipments 27,092,000 compared with production during June of 31,105,000 and shipments of 27,251,000. Stock on hand of 78,835,000 brick is reported.

July shipments were made into 30 states and Canada, with Ohio leading in consumption followed by Illinois, Texas, Iowa and Pennsylvania in the order named.

JUDICIAL DECISION DEFINES LOWEST RESPONSIBLE BIDDER

Throwing light on the discretion that may be exercised by public boards in awarding a contract on competitive bids, under a statutory requirement for an award to the lowest responsible bidder, the Pennsylvania Supreme Court said in



This street in York Village, Maine, was first treated with Tarvia in 1913.

A macadam road brought up to date. Main Street, Le Roy, New York—transformed by Tarvia during 1919 and 1920.

Columbia Avenue, Vandergrift, Pa., once an old brick street, was surfaced with Tarvia in 1914.

The Three Ages of Main Street—

What are the three ages of America's Main Streets? First, the Age of Mud and Dust—the age of the sprinkling cart—the age when spring thaws turned Main Street into a mud-hole.

Next, the Age of Incompleteness. In this period, a few blocks of Main Street were given a fine, expensive pavement. Then came an abrupt break-off into unimproved country roads.

And today—the Age of Tarvia.

Main Street has been extended. Instead of short stretches of ultra-expensive pavement, the public now demands the greatest possible mileage of good roads that the available funds will permit.

To meet this demand, experienced road officials are constructing moderate priced, low maintenance Tarvia Roads. Moreover by the use of Tarvia they are transforming at small expense worn-out macadam into modern "all-year" highways.

Tarvia roads are not only firm, smooth, dustless and mudless all the year round, they are far less costly to build and maintain than any other type of modern highway. There is a grade of Tarvia for every road purpose—new construction, reconstruction, repairs and maintenance.

If you will write to our nearest office we will promptly and gladly give you practical cooperation in solving your road problems.

Tarvia
For Road Construction Repair and Maintenance

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland
Cincinnati Pittsburgh Detroit Kansas City Birmingham Dallas
Minneapolis Salt Lake City Bethlehem Lebanon Youngstown Milwaukee
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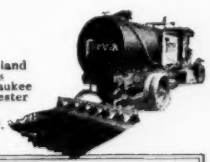


State Street, Hart, Michigan, first treated with Tarvia in 1913.

the late case of Hibbs v. Arensberg, 119 Atlantic Reporter, 727:

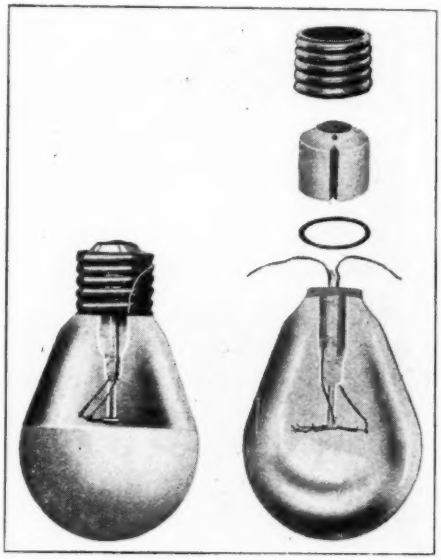
"The term 'lowest responsible bidder' does not mean the lowest bidder in dollars; nor does it mean the board may capriciously select a higher bidder regardless of responsibility or cost. What the law requires is the exercise of a sound discretion by the directors. They should call to their assistance the means of information at hand to form an intelligent judgment. They should investigate the bidders to learn their financial standing, reputation, experience, resources, facilities, judgment, and efficiency as builders. This was not done. The Court below censures the board for omitting this important step, but it holds, inasmuch as they had ample knowledge of the successful bidder and the merit of its work, the contract could be awarded. This might do in private affairs, but will not pass when public funds are at stake; it is not the exercise of discretion. Though the directors were not bound in law to give the contract to the lowest bidder, who might be irresponsible, they were bound to investigate, and if a bidder measured up to the law's requirement as a responsible party, the board could not capriciously award the contract to another. Giving a bond alone does not make up for responsibility; we have too many bonding companies willing to indemnify almost anything. But there should be a sufficient reason, where a bidder is lowest and responsible, why the job was not given to him. And where such reason appears, the action of the board is generally conclusive."

KULP THEFT-PROOF ELECTRIC BULB

It is estimated that from 15 to 30% of the electric light bulbs used by railroads, industrial plants, hotels, apartment houses, ships, schools, theatres, stores and public places of all kinds, are stolen. One railroad claims a loss of over $13,000 annually; another shows figures of over 3,000 lamps vanished in ten months; a hotel association finds that over a million bulbs are stolen annually from its members.

And this loss in dollars, tremendous as it seems, is said to be actually doubled by the cost in time and labor to make replacements. There is, too, the loss of work due to lack of light, and the ever-present danger of accidents in dark places, from which lamps have been removed. In some locations as in hotels, heavy current using utensils are connected to lamp sockets, frequently burning out fuses, and whole circuits, with attendant fire risk and cost of repairs.

The new Kulp Theft-Proof Bulb, designed to prevent all such loss and danger, is just being placed on the market by Lester Kulp, 143 W. Austin Ave., Chicago. The remarkable simplicity of the idea particularly recommends it, as there are no guards, locks, keys, springs, or other mechanisms. It is a standard lamp in every way, that fits into any standard socket—complete in itself and looks and is



THEKULP THEFT-PROOF ELECTRIC BULB.

used exactly the same as an ordinary lamp. And more important still, it carries no extra cost for theft protection, for it is planned to sell this bulb at regular standard prices.

The illustration shows how these unusual advantages are obtained. One contact is at the top just as in ordinary lamp. The other contact is a brass ring, fastened at the bottom of a porcelain plug. This plug has a groove which is filled with plaster of paris, lightly holding the brass shell in place. After the lamp is screwed into the socket, an extra turn breaks the plaster of paris seal, so that the lamp can turn freely in the shell, always maintaining electrical contact. The shell, however, cannot be turned in the socket. The shell being spun over

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Water Cleaning System, if you wish it, or Drag Bucket type.

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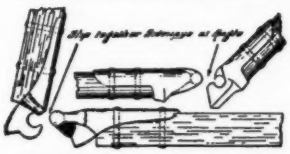

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HERE is just the type of power drag scraper outfit—inexpensive, easily moved from place to place—that owners of small gravel pits, county highway commissioners and contractors have been looking for. Write for folder.
Sauerman Bros., 458 S. Clinton St. CHICAGO
SAUERMAN PORTABLE POWER SCRAPER
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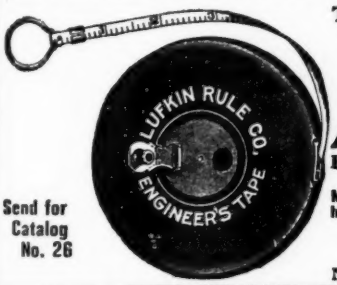

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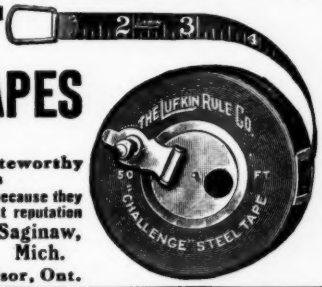

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the ring, screws up so close to the socket that fingers or tools cannot grasp it. Thus the lamp positively cannot be stolen or even broken in the attempt to steal it, thus preventing endangering circuits.

When the bulb is burned out, it can easily be removed for replacement. The bulbs come in any standard size, voltage or wattage.

USING DYNAMITE IN MOSQUITO ERADICATION

Dynamite is one of the latest agents to be employed extensively in the war against mosquitoes. It has been used in many places in Virginia to blast ditches throughout mosquito-infested swamps and lowlands to drain out the breeding places of the pests. Experts of the United States Health Service have used it repeatedly. It has been employed in Alabama in municipal mosquito control work, in Arkansas, Texas, Florida and in other states. The control of the explosive is such at the present time that the experts can blow a ditch as desired. By employing it in certain amounts, placing it at certain depths and in certain lines, they can make the ditch shallow or deep, wide or narrow. One of the interesting methods is to shoot dynamite by the propagated method, as it is called. In this use, one dynamite cartridge detonates another, so that by placing a cap in one, the entire row of cartridges, placed at intervals, and sometimes extending for the distance of a mile, can be exploded by the one charge from a blasting machine.

Engineers in various parts of the South have found dynamite especially valuable for ditching under adverse conditions where there were trees, stumps, heavy bushes, or other obstructions in the right of way. Under ordinary conditions with hand labor or with dredges, the right of way would have to be cleared before the actual operation of ditch digging began, but with dynamite, all the obstructions are blown out together with the earth, so that a great deal of time and labor are saved.

Another feature of dynamite when used for ditch blasting is that it leaves no spoil banks to drain back into the ditch. It blows the dirt into the air and scatters it around on the landscapes. The engineers of the Virginia State Board of Health found that under certain conditions they could cut the cost of ditching 50 per cent by using the explosive. Farmers in Northern New York found that the cost of digging ditches by dynamite was 20 cts. less per rod than by the hand method. Plantation engineers in Florida found that they could reduce the costs of ditching from 25 to 50 percent by using the explosive. In many places where there is a shortage of hand labor, or costs of labor are high, dynamite has proved to be the most economical agent, besides being far more efficient.

The mosquito has to face an aroused public opinion. Health officers say that he must go. They say that with sufficient men and money they can always eradicate him. With the reports coming in on dynamite as an efficient anti-mosquio agent, it seems entirely possible that proper drainage can be so widely carried on as to bring the pest under complete control.

WORK OF THE PLAYGROUND AND RECREATION ASSOCIATION

The Playground and Recreation Association of America, with its 17 years of experience, is ready to help cities and towns with their recreation problems. It exists only for service and is non-political, non-commercial and non-sectarian. The Association offers four major lines of help as follows:

1. Through literature, much of which can be had free of charge.
2. Through counsel by correspondence.
3. Through co-operation in getting through legislation for clearing the road to municipalities that really want to do something in this field.
4. Through the field staff, available for consultation, recreation surveying, community recreation program making, and practical promotion.

Mr. Eugene T. Lies, Special Representative, 21 N. La Salle St., Chicago, is available for speaking appointments before important civic, educational, religious and technical bodies interested in community projects.

NOTICE TO BIDDERS.
BERWICK (PENNSYLVANIA) SEWERAGE SYSTEM.

Bids will be received by the Borough of Berwick, Pa., until 7 p. m., Eastern Standard Time, September 26, 1923, at the Borough Hall, for the construction of 4,300 ft. of combined sewers, varying in size from 22 ins. to 48 ins.

Plans and specifications may be had from the undersigned or from Alexander Potter, Consulting Engineer, 50 Church Street, New York City, upon payment of Ten Dollars ($10.00), which will not be refunded. Each bid to be accompanied by a certified check of five per cent (5%) of the amount of the bid.

The right is reserved to reject any and all bids.

SILAS McHENRY,
Secretary of Council.

Contracts Awarded

ROADS AND STREETS

Ala., Montgomery—W. C. Hill, awarded contract for 16.25 miles chert road in Blount Co., at $127.-264; Etowah County Commrs., Gadsden, contract for bldg. 2.35 miles concrete road in Etowah Co., at $62,786.

Ala., Montgomery—Stanley & Singer Construction Co., Lafayette, Ala. awarded contract for road projects as follows: 22.79 miles gravel rd., Walker Co., at $515,982. 10.75 miles gravel road in Parry Co. Stanley and Singer Construction Co., at $157,410.

Ariz., Phoenix—Phoenix-Tempe Stone Co., Phoenix, awarded contract by State Hwy. Dept., for constr. of Fed. Aid. Proj. 65, Mesa-Superior hwy., at $130,236.

Ariz., Prescott—Henry Galbraith, Jerome, awarded contract by Yavapai Co. hwy. commission for constr. of sec. D, Camp Verde-Fossil Creek hwy., approx. 10.62 miles in length, at $204.000.

Cal., Calistoga—J. F. Knapp, Box 595, Ontario, awarded contract for impvt. of various streets, City of Calistoga, Napa Co., involving 474,900 sq. ft. 5-in. conc. paving, at $136,026.

Cal., Fullerton—L. A. Paving Co., 2900 Santa Fe Ave., Los Angeles, awarded contract by City Council for paving portions of W. Santa Fe Ave., and other streets, involving 95,309 sq. ft. 5-in. Warrenite paving at 23.5c ft.; 764,380 sq. ft. 4-in. Warrenite paving at 21.9c ft.; 2,900 ft. curb at 60c ft. removal and reconstr. of curbs, $295,92; installing headers, $22; headers, $427,50; 1,400 ft. shepardized conduit at 60c ft. Total cost $192,824.97.

Cal., Glendale—Peter L. Ferry, Glendale, awarded contract for impvt. of Glendale Ave., at $157,534.

Cal., Huntington Beach—G. M. Souter, care 200 Luckenbach Bldg., Los Angeles, awarded contract by City for paving Ocean Ave. with 2-in. Willite on 4-in. conc. base, at $238,900.

Cal., Oakland—Kaiser Paving Co., American Bank Bldg., Oakland, awarded contract by Co. Supvrs., for paving hwy. bet. Pleasanton and Livermore; also San Ramon Rd.—Dublin to Contra Costa line, using 5-in conc. base with edges thickened to 7-in. approx. 8 miles, at $175,006.

Cal., Santa Ana—Geo. R. Curtis, 2440 E. 26th St., Los Angeles, awarded contract by County Supvrs., for impvt. of principal street in La Habra, at $205,000. Work involves 560,000 sq. ft. 1½ in. Warrenite bitulithic surface on 3½ in. asph. conc. base; curbs, walks, culverts, etc.

Cal, Santa Paula—Jas. P. Cornwall, 227 Equestrian Ave., Santa Barbara, awarded contract for impvt. of various streets under Res. No. 48, at $65,723; Southwest Paving Co., 806 Washington Bldg., Los Angeles, awarded contract for paving various sts., at $136,956.

Conn., Hartford—State Hwy. Dept., Hartford, awarded folliwing contracts for paving: J. Arborio, 82 Church St., New Haven, paving 18,850 sq. yds. Southbury Rd., 3-in. bitum, macadam, etc., at $44,-639; 36,900 sq. yds. Bethlehem Rd., 8-in. native stone, at $80,214; Lane Constr. Co., 37 Colony St., Meridan, 51,000 sq. yds. road in Sharon and Salisbury, 7-in. macadam, at $300,544.

Fla., Deland—Inglis Construction Co., Jacksonville, Fla. awarded contract to pave 95,000 sq. yds. street with concrete, at $300,000.

Fla., Deland—Jas T. Wilson, Jacksonville, awarded contract by Volusia County for culverts, bridges and rock base of roads; Geo. Abbott, New Smyrna, contract for laying Coquina rock(compacted on top of present shell; total cost $360,000.

Fla., Tallahassee—Hutton Engrg. and Contracting Co., Savannah, Ga., awarded contract for paving City streets, at $188,913.

Fla., Tallahassee—W. P. McDonald Constr. Co., Tampa, awarded contr. by State Rd. Dept., for sheet asphalt surfacing 7.962 miles road from Paynes Prairie to Marion Co., line, 30 ft., Alachua Co., at $302,609.

Ill., Chicago—R. F. Conway Co., 133 W. Washington St. contract for paving drives in Sherman Park at $50,124; paving West Drive in Grant Park and exttension of Roosevelt Rd., at $189,371.

Ill., Olney—Wabash Constr. Co., Vincennes, Ind., awarded contract for 50,000 sq. yds. paving, 31,000 ft. conc. curb, 14,000 c. y. excav., etc., at $160,000.

Ind., Indianapolis—Contracts let by State Hwy. Comm., as follows: Grading 8.269 miles Proj. 34D and 24A. Spencer and Perry Cos., to Van Hay Construction Co., Loogootee, at $70,067; 7.292 mi. Proj. 42D, Crawford Co., to R. W. Martin, Evansville, at $67,057; 5.002 miles, Proj. 59, Scott Co., to Kelly & Young, Frankfort, at $80,747.

Kans., Kansas City—Cook & O'Brien Constr. Co., 305 Railway Exch. Bldg., Kans. City, Mo., awarded contract for conc. rd., Wyandotte Co., at $184,-462.

Ky., Henderson—Anderson Asphalt Paving Co., Hamilton, Ohio, awarded contract for paving with sheet asph. and Warrenite bitulithic on 6-in. conc. foundation, at $174,500, Main Green, Elm and Washington Streets.

Mich., Ishpeming—S. J. Groves & Sons Co., 120 Manhattan Bldg., awarded contract for road work in Marquette Co., at $163,757.

Get Publicity

on your activities by giving us the facts.

What are you doing that would interest others?

Are you planning an improvement? Are you calling for bids? Have you awarded a contract?

What special studies are you making? What have you learned recently?

Tell us that we may tell others.

Municipal and County Engineering

222 East Ohio Street
INDIANAPOLIS, INDIANA

Mich., Lansing—Following Fed. Aid contracts let: F. A. Monroe Co., Bedford & Erie Twps. Cl. G & DS, 5.455 mi. to Hudson & Coons, Owosso, Mich., at $50,002; F. A. 73-B, Monroe Co., Erie & LaSalle Twps. Cl. G and DS, 5.342 mi., to C. L. Dunbar, Detroit, Mich., at $53,403; F. A. 73, D & F, Monroe Co. La Salle and Monroe Twps., Cl. G & DS, 3.857 mi., to Koch Bldg. & Supply Co., Ann Arbor, Mich., at $30,349; F. A. 99, Kalamazoo Co. Portage & Kalamazoo Twps., Cl. F-rein, 18 ft. wide, 7.369 mi. to Webber Co., Ionia, Mich., at $139,675; F. A. 89 ABC, Calhoun Co. Sheridan Twp. and City of Albion, Cl. F-rein., 20 ft. wide, 2.456 to Rockford Constr. Co., Rockford, O., at $58,896; F. A. 124, Clinton Co., Greensburgh Twp., Cl. B, 18 ft. wide, 2.919 mi., to Byam & Whitmore, Grand Ledge, Mich., at $29,463. Mich. State Trunk Line contracts let as follows: 27-17 A, St. Clair Co., Clay Twp. Cl. D & DS, 1.788 mi. to Closser Bros., Detroit, at $19,932; 27-17, B, St. Clair Co., Clay & Cotterellville Twps., Cl. F-rein., 18 ft. wide, 3.015 mi. to J. H. Baker & Sons, Pt. Huron, at $70,766; 11-16, Emmet Co., Vil. of Alanson, Cl. F-rein., 18 ft. wide, 1.121 mi. to Edw. Cozens, Levering, Mich., at $22,-251; Rd. 13-47, Mecosta Co. Green Twp. Cl. Conc. culvert, to J. W. McKnight, Rosebush, Mich., at $4,030; 11-22, Berrien Co., Benton Twp. Cl. F-rein., 20-ft. wide, 1.769 mi. to Woodby Granger & Granson, Benton Harbor, at $43,826; Rd. 53-6, Lapeer Co., Inlay City, Cl. F. asph., 20-56 ft. wide, 1.251 mi. to Willite Rd. Const. Co., Detroit, Mich., at $71,955; 13-44, A, St. Jos. Co., Mottville Twp. Cl. G & DS, 1.088 mi., to M. E. Stukey, Montgomery, at $6,951; 14-14, Clinton Co. Greenbush Twp., Cl. B, 16 ft. wide, 2.409 mi. to Byam & Whitmore, Grand Ledge, at $23,699; 17-13, Calhoun Co., City of Albion, Cl. F-rein., 20 ft. wide, 1.084 mi. to Rockford Constr. Co., Rockford, O., at $24,768; Rd. 13-15, Gd. Traverse Co., Fife Lake Twp. and Vil. of of Fife Lake, Cl. F-rein., 20 ft. wide, 1.234 mi., to Hersey Gravel Co., Hersey, Mich., at $26,918. Genesee County Rd. Comn., let contract to Allen, Becker & Hall, Fenton, Mich., at $34,803 for 4 miles gravel rd., to Sculley-Putnam Co., Goodrich, Mich., at $38,831; 4½ mi. grav. rd. to Hill Constr. Co. Davison, Mich., at $33,175.

Minn., St. Paul—Grant Smith & Co., 1505 Pioneer Bldg., St. Paul, awarded contract for paving State project 45-21, 10.7 miles bet. St. Paul and Stillwater at $388,893. Work involves 117,000 sq. yds. conc. paving.

Miss., Aberdeen—Addison Brannin, Aberdeen, awarded contr. to construct 8 miles conc. road, at $100,000.

Miss., Grenada—J. R. Strouddy, Okolona, Miss., awarded contract for bldg. 16 miles gravel rd. from corp. limits of Grenada westward thru Dubard, Holcomb, Foxbury to Tallahatchie Co. line, at $115,940.

Miss., Fort Gibson—Clark & Junkin, Vicksburg, Miss., awarded contr. to build 7.8 miles gravel hwy. bet. Port Gibson and Vicksburg in Claiborne Co., at $99,950.

Miss., Jackson—Clark & Junkin, Vicksburg, awarded contract for constr. of 7.8 miles gravel hwy., Claiborne Co., bet. Port Gibson and Vicksburg, at $99,950.

Miss., Pascagoula—S. A. Gano, New Orleans, La., awarded contract for b'dg 14 mi'es concrete road from Gauntier to Ocean Springs on Spanish Trail, at $414,355.

N. J., Mays Landing—C. H. Earle, Chelsea Bank Bldg., Atlantic City, awarded contract for repairing or reconstructing Absecon Blvd.; also additions to 9 bridge, at $935,712.

N. J., Newark—Franklin Contg. Co., 20 Washington Park, Newark, awarded contract for 3-in. sheet asph. on 6-in. concrete, at $106,455; draining above street to P. Lordi, 147 Bloomfield Ave., at $22,392.

N. C., Troy—W. F. Bowe, Augusta, Ga., awarded contract to pave streets of Town, at approx. $175,000.

N. Dak., Hillsboro—Stevenson, Miller & Lucket, Civil Engrg. Co., Fargo, awarded contract for paving, at $140,000.

N. D., Valley City—Haggart Construction Co., Fargo, awarded contract for 21,000 sq. yds. paving at about $100,000; bitulithic; also contract for about ½-miles bitulithic pavement in Morton Co. on hwy. bet. Mandan and New Missouri river brdg., at $28,-000.

Ohio, Akron—T. E. McShaffrey Constr. Co., 171 S. Forge St., awarded contract for paving Barberton Springfield Co. Hwy., 1.945 mi. Sec. A, 20 ft., at $74,817 (Trinidad).

Ohio, Cincinnati—A. J. Brehm, 57 Wiggins Blk., awarded contract for paving 60,000 sq. yds. Cleves-Warsaw Rd. with bitulithic, at $491,493.

Ohio, Warren—F. George, General Delivery, Youngstown, awarded contract for paving S. Main St., brick on 7-in. concrete, at $147,243.

Okla., Hooker—J. Stanton, 6th & Kiowa Sts., Leavenworth, Kans., awarded contract for curbing, guttering and brk. paving on various streets; brick at $4.30; curb and gutter, $1.25; gutter, $1.30, etc. ttotal cost $109,399.

Pa., Ebensburg—J. L. Elder, Jr., Ebensburg, awarded contract for paving 3.25 mi. rd. from Emeigh Run to Plattsville, 16 ft. rein. conc. and Hillside brick, on concrete, at $206,333.

Penn., Erie—Contract for paving Shore, Shawnee and Seminole drives, to M. A. McCormick, Erie, at $3.15 per sq. yd., Frontier and Hohawk drives to J. and M. Doyle Constr. Co., Erie, $3.15 per sq. yd. Above work involves 57,672 sq. yds. asphalt on concrete. Engineer's est. of impvt. $250,000.

Pa., Greensburg—R. H. Cunningham Sons Co., Turtle Creek, awarded contract for rein. conc. paving 2⅞ miles Herminie Rillton Rd., Sewickley Twp., 16 ft., at $122.838.

Pa., Wash—Petriello Bros., Brownsville, awarded contract for paving 1 mile E. Pike Penn Run Twp.,—brk. on 5-in. conc., at $103,000.

Tenn., Greenville—Stacey Brothers, Augusta, Ga., awarded contract for street paving here at approx. $150,000.

Tenn., Martin—Murphy & Hall Constr. Co., Martin, awarded contract for graveling, asphaltic oil and rock asphalt surfacing on 10 miles various streets, at $167,889.

Tenn., Nashville—Board of Public Works awarded contracts for 8 permanent street paving projects, totaling $177,340 in cost, to David Turner, Rodes-Eller Constr. Co., Rodes-Carr Co., G. B. Howard Co. and O. H. Looney.

Tenn., Nashville—State Hwy. Dept., let contracts for road projs. as follows: F. A. P. 94, Benton Co., 7.99 mi. chert surfaced hwy. bet. Camden and Carroll Co. line to Little & Dean, Memphis, at approx. $154,570; FAP 96, Bedford Co., 11.02 mi. bitum. macadam roadway bet. Shelbyville and Rutherford Co. Line to Boyd Williams, Murfreesboro, at approx. $222,257; St. Proj. 115, Lewis Co., 7.53 mi. chert surfaced hwy. bet. Hohenwald and Perry Co. Line, C. & G. Constr. Co., at approx. $57,161; St. Proj. 126, Sumner Co., 10.78 mi. rock asph. surfaced hwy. bet. Gallatin and Bethpage, to Rhodes-Carr Co., Nashville, at approx. $162,074; State Proj. 127, Sumner Co., 12.5 mi. gravel surfaced hwy. bet. Bethpage and Ky. St. line to S. W. Brown, at approx. $111,149.

Va., Richmond—State Hwy. Dept let contracts for 3 road projs., as follows: 10.7 mi. gravel rd., Providence Forge to Bottoms Brdg., Richmond-Newport News hwy. to Van Dorn Bros., Richmond, at $114,550; sec. of Lee Hwy., Fall's Ch. to Hall's Hill, Crawford Paving Co., Washington, D. C.; grave'ing roadway bet. King Wm. Court House and Sharon Church to C. H. Oliver, at $50,970.

Wash., Seattle—Olympia Construction Co., 1326 Northlake Ave., awarded contract by Bd. Pub. Wks., for paving 15th Ave, et al, at $112,762; J. B. Covello, contract for 63rd Ave. south paving, at $22,712.

Wash., Spokane—Triangle Construction Co. and Albert L. Smith, both Spokane, awarded contracts as follows for work in Baker, Oregon: Triangle award. contr. for gravel-surfacing several streets and for bldg. concrete cross forks and curbing, at $55,000; Smith, contract for laying concrete pavement and sidewalks. Total Cost $200,000.

W. Va., Bluefield—The Mur-Mun Co. and Rusenheir & Pemberton awarded contract for resurfacing brick pavements, sheet asphalt and bitum. conc. streets, at $120,000. 18,000 sq. yds. resurfacing and 12,000 sq. yds new pavement.

W. Va., Fairmont—Rogers & Shumway, Worthington, awarded contract for concrete paving, 17,-846 ft., on Morgantown Rd., Winfield Dist., at $85,-768.

Wis., Milwaukee—Brennan & Bounsall, 709 Exch. St., Kenosha, awarded contract by State Hwy. Dept., for 40,000 sq. yds. conc. surfacing, etc., on Kilbourn Rd., Racine County, at $84,292.

Wyo., Sheridan—Warren Constr. Co., Park Rose, Portland, Ore., awarded contract for paving Wyoming Ave., Summer, Illinois, E. Loucks, E.

Works, E. Burkitt, Park, Jefferson, Dow and Gould Sts., with Warrenite bitulithic; bitulithic base, $148,517 or conc. base, $156,123. Engineer's est. $175,000.

SEWERAGE AND SEWAGE TREATMENT

Ark., Gehee—Merkle Machinery & Construction Co. awarded contract to construct sanitary sewer system, at $85,306.

Cal., Anaheim—Following awards made for Anahein-Fullerton-Orange joint outfall sewers: Unit No. 2, 17,300 ft. 30-in. conc. pipe, 12,278 ft. 27-in. conc. pipe; 27 manholes and 1,150 ft. pile trestle, to C. E. Green, Los Angeles, at $143,751; Unit No. 3: 13,828 ft. 27-in. conc. pipe, 5,063 ft. 24-in. vit. pipe and 18 manholes; Cox & Teget, Alhambra, at $69,025; Unit No. 4: 8,622 ft. 24-in. vit. pipe and 7 manholes, to Downer & Mero, Richmond, at $25,-676.

Cal., Los Angeles—Contracts for 4 complete sects. of north outfall sewer for City awarded by Board of Pub. Works. Sections comprise total of 29,226 lin. ft. sewer, ranging from 6 ft. 3-ins. to 7 ft. 6-in., in diam. Total contract price is $1,474,052, including labor and materials, or $50,43 per ft. Pre-cast rein. conc. pipe with vitrified lining decided upon as material and this contract was awarded to Western Rein. Conc. Pipe Co., at $863,154; Thos. Haverty Co., secured contract for trenching and backfilling, also laying pipe on all 4 sections, at $651,740.

Ky., Ashland—S. L. Fluss Contracting Co., Graham, Va., award. contract to lay 25 miles san. sewers in various sections, at $270,026.

Il., Chicago—J. Griffiith & Sons Co., 112 W. Adams St., Chicago, awarded contract by San. Dist., for constr. of No. Side sewage treatment works, div. A—aeration tanks, settling tanks, operating galleries, etc., at $5,602,636.

Md., Baltimore—Consolidated Engrg. Co., Calvert Bldg., Baltimore, awarded contract for 3 sludge digesting tanks 18 ft. deep, 90x114 ft. conc. and for 2 drying beds, 100x400 ft. at sewage disp. wks. at Back River, at $160,309.

Mo., Lathrop—Burt & Tripp, Hutchinson, Kans., awarded contract for sewerage and water systems, at $101,309.

Mo., Kansas City—W. C. Mullins Constr. Co., 419 Nelson Bldg., awarded contract for monolithic conc. sewer in Dist. 457, at 73,403.

Mo., Maplewood—(St. Louis, P. O.)—Frazier-Davis Constr. Co., Arcade Bldg., St. Louis, awarded contract for 15,640 ft. 8-36 in. vit. clay and 500 ft. 42-in. segmental blk., san. and storm water sewers in Manchester Sewer Dist. No. 2, at $97,-264.

Mo., Richmond Hts.—(St. Louis, P. O.)—R. B. Clarke, Cape Girardeau, Mo., awarded contract for constr. of sewer dist. at Rankin Blvd. and Penn Ave.; also constr. of road on Bellevue Ave., at $125,000.

N. Y., Long Island City—F. J. Kelly Co., Inc. 186 Joralemon St., Brooklyn, awarded contract for sewers in 25th and 27th Sts., at $368,581.

N. Y., Long Island City—Awixa Corp., Mt. Vernon, awarded contract for sewer in 25th Street, at $652,211.

N. Y., Syracuse—J. Young, 620 S. Salina St., awarded contract for 1,525 ft. 10x11 ft. concrete and rein. conc. storm sewer in Erie Canal and Clinton to Salina Sts., at $100,000.

Ohio, Cleveland—Following contracts let for sewers: 2,661 ft. 12-24-in. vit. tile sewer in Catalpa Rd. to Yahya Bros., 591 Broadway Rd., at $13,-613; 1,135 ft. 5 ft. 9-in. and 765 ft. 6-in. circ. E sewer in E. 141st St., to G. Darwich, 2914 Kempton Ave., at $38,738; 4,000 ft. 27x33 egg shape outfall sewer in Ridge Rd. Impvt. 20, Sec. C of County Sewer Dist. 1, to Manson Company, c/o Sewer Contractors Exch., The Arcade, at $56,530.

Ohio, Delaware—Pitt Constr. Co., Fulton Bldg., Pittsburgh, Pa., awarded contract for sewage disposal plant, at Girls' Indust. Home here, at $129,-110.

Ohio, Youngstown—Turner Contracting Co., Park Theatre Bldg., awarded contract for 5½ miles sewers and 2½ mi. water mains in Brookfield Twp. San. Sewer Dist. 2, at $100,118.

Penn., Erie—W. Bancroft, Erie, awarded contract for west side interceptor sewer from 4th and Cranberry Sts., to Rosemount Ave. in Kahkwa Park, at $123,000.

Tex., Houston—Scott Shambaugh, awarded contract to install storm sewer in Woodland Heights Addn., at $87,000.

Wis., Milwaukee—H. Hohensee, Ludington Ave., award. contract for rein. conc. sewer tunnel in Schiller and Jordan Sts., Howell and Okla. Aves., at $227,402. P. Riesens Sons, 1018 Humboldt Ave., Milwaukee, awarded contract for Sewerage Comn., for conc. foundation for 220x330 ft. filter and dryer house on Jones Island, at $113,833. M. Synovitz, 944 2nd Ave., awarded contract for storm sewers in Lincoln Ave., at $111,116; W. T. Werner, 675 Hi Mount Blvd., contr. for sewers at $19,889.

WATER SUPPLY AND PURIFICATION

Ark., Ft. Smith—Benson & Farrar, Guthrie, Okla., awarded contr. by City to construct 70,000 lin. ft. water mains and pipe, at $39,239.

Ark., Paragould—J. B. McCrary Engineering Co., Atlanta, Ga., awarded contract for water works system, at $91,425.

Ark., Van Buren—Ajax Constr. Co., Okla. City and J. S. Terry, Poteau, Okla., awarded contract for filtration plant, new pump house and laying mains, at $67,911.

Que., Bagotville—Albert Forton, Bagotville, awarded contract by Town Council for hydro-power plant equipment, at $125,000. No materials purchased. J. F. Grenon, Chicoutimi, Que.

Ont., Campbellford—Sinclair Constr. Co., Ltd., Excelsior Life Bldg., Toronto, awarded general contr. for construction of power house, foundations and tailrace at Dam No. 1, Trent River, in connection with the $250,000 development here for the Hydro-Electric Power Comn., of Ontario University Ave., Toronto.

Ont., Etobicoke Twp.—Louis Sacco, 596 Ferry St., Niagara Falls, Ont., awarded contract for laying water mains in Earlwood Park Area and O'Connor subdivision, at $40,000.

Que., Levis—R. T. Smith & Co., Montreal, awarded contract by City Council in connection with $130,000 filtration plant; Francis Hankin, 598 Union Ave., Montreal, awarded contract for filtration equipment.

Que., Montreal—Laurin & Leitch, 590 Union Ave., awarded contr. for 6,500 ft. 48-in. cast iron force main in Atwater Ave. and St. Patrick St., at $157,-725.

Conn., Newington—A. D. Marco, 61 East Main St., Plainville, award. contract for Center Fire Dist., 7 miles c. i. pipe, various sizes; at $120,000.

D. C., Washington—M. A. Long Co., 19 Guilford Ave., Baltimore, Md., awarded contract by Major Jas. A. O'Connor, Dist. Officer in Charge of Water Supply System, at $368,708, for constr. of new conduit and auxiliaries at Great Falls and vicinity. Contract involves constr. of intake chamber or gate house, bldg. 350 ft. conduit connections and tunneling 2,400 ft. solid rock.

Ill., West Chicago—P. P. Kuehn, Aurora; awarded contract for water mains here, at $36,200.

Ia., Dubuque—Dayton-Dowd Co., Quincy, Ill., awarded contract for 2 centrif. pumps, at $5,270 and $3,810 respectively; F. H. Dormer, 548 Milwaukee St., Milwaukee, Venturi meters, $2,550; Swords Bros., Rockford, Ill., switchbds., $2,625; Sullivan Mchy. Co., 124 S. Michigan Ave., Chicago, air lift equipt., at $5,580; 2 motor driven compressors, at $30,741.

Md., Baltimore—A. P. Smith, Norman Street, E. Orange, awarded contract for valves for Water Dept., at $64,000. Wentworth & Co., Cumberland, Md., awarded contr. to construct extension to water works; concrete, 4,000 gals. capacity, at about $55,000.

Mich., Ecorse—T. C. Brooks, Jackson, awarded contract for 48,020 lin. ft. 4-8 in. cast iron mains, at $100,000.

N. C., Raleigh—City Commrs. let following contracts for constr. and equipment for filter plants: Tucker & Laxton, Charlotte, N. C., at $124,178 for new filtering plants of 500,000 gals. capy. each, conditioning of present 7 filters, constructing coagulating basin to serve new plant and construct filter tubs and bldgs.; C. H. Wheeler Mfg. Co., Philadelphia, Pa., contract for condensers and vacuum pumps.

Ohio, Bedford—Gantose Constr. Co., Columbia Bldg., Cleveland, awarded contract for 5 to 6 mi. of 6 and 8 inch cast iron mains, at $140,000.

Ohio, Cleveland—National Valve & Mfg. Co.,

3101 Liberty Ave., Pittsburgh, Pa., awarded contract for main pumping units at Fairmount Pumping Sta., at $66,976.

Ohio, Cleveland—Langahan Constr. Co., Marshall Bldg., awarded contract for 4,800 ft. 12-in. cast iron pipe, Sec. B, Impvt. 20, Co. Sewer Dist., at $30,250; D. Lowensohn, 10823 Fairchild Ave., award. contract for 2,390 tons cast iron mains, 11,500 c. y. excav. on West Side, Sec. 1, at $123,000.

Ohio, Lyndhurst—(Cleveland Hts., P. O.)—Contract for 8,080 ft. 6 and 8 inch cast iron mains in Churchill and Winchester Rds., to A. Narra Co., Ulmer Bldg., Cleveland, at $21,364; 11,610 ft. 6 and 8 in. c. i. mains in Gordon Rd. Sunview and Irene Aves., to A. C. Hattendorf, Stop 14, Euclid Av., Cleveland, at $32,254.

Okla., Tulsa—De Lacalle Co., New York, awarded contract by Water Board for pumping equipment for Mohawk Reservoir, at $82,000.

Okla., Woodward—General contract for water works system let to Tibbets & Pleasant, 229 N. Nogales St., Tulsa, at $40,000; foundations to W. C. Ward, Woodward, at $7,000; wells to Well Works Mfg. Co., Garden City, $7,000; pipe to U. S. Cast Iron Pipe & Fdry. Co., 604 Interstate Bldg., Kansas City, Mo., $84,000; valves to Ludlow Valve Mfg. Co., 1416 R. A. Long Bldg., Kans. City, Mo., at $2,000; 1 m. g. steel storage tank to Chicago Bridge & Iron Works, 608 S. Dearborn St., Chicago, at $18,250.

Pa., Dubois—C. Hatten & Co., Dubois, awarded contract for rein. conc. reservoir, 165 ft. inside diam., 16 ft. high, 500 ft. 12-in. terra cotta, etc., at $78,500.

Tex., Beaumont—Pittsburgh-Des Moines Steel Co., Pittsburgh, awarded contract to construct steel water tank, at $31,500.

Tex., Ft. Worth—A. M. Lockett Co., Magnolia Bldg., Dallas, award. contract for water works system for Polytechnic Heights, booster plant and machinery, at $14,897; mains to H. W. Greenway, 214 Hemphill St., $71,036.

Tex., Galveston—Fairbanks, Morse Co., Chicago, Ill., Briggs-Weaver Co., Dallas, Tex. and Southern Engine and Pump Co., awarded contract for rehabilitation of Alto Lamo and Galveston water plants, at $123,700; will install pumps. $125,000 bonds voted.

Tex., Marlin—McCall & Moore, Waco, awarded contract to erect filtration plant and pump house, at $20,155; International Filtering Co., Chicago, Ill., at $16,290 for filter equipt.

Va., Richmond—Claiborne & Taylor, Richmond, awarded contract for pumping station in Byrd Park; conc. found.; slag roof; steam heat. Approx. cost $99,130.

Wash., Camas—H. W. Troutman & Co., Securities Bldg., Seattle, awarded contract for hauling and laying 8.5 miles 8 and 10 in. welded steel pipe, furnishing and placing pipe line appurts., bldg. intake structs. and steel tank, 50,000 gals. capy., at $41,996.

Wis., Marshfield—Layne-Bowler Co., Chicago, (main office, Memphis, Tenn.) awarded contract to secure addnl. water supply; furnish 2,000,000 gals. water every 24 hrs. and keep test for 1 yr. piping water mains, pumps, pump houses and other equipt., at $160,000.

Wyo., Rawlins—Continental Pipe Mfg. Co., 4519 14th St., N. W., Seattle, Wash, awarded contract for 40 miles 16-in. gravity line creo. Continental wood pipe; total est. cost $600.000.

Prospective Work

ROADS AND STREETS

Ariz., Tucson—Black Canyon Hwy. Assn., has requested Tucson Chamber of Com. to assist in securing hwy. to Bradshaw Mountain resorts. Maricopa Co. Supervisors have provided $25,000 toward cost. Prelim. plans for paving E Speedway—Stone Ave. to City limits—adopted. Est. cost $125,000. Impvt. will consist of some stand. type paving, 46 ft. wide; curbs, walks and gutters. Work is approx. 2¼ miles long. G. H. Atcheley, City Engr.

Cal., Bakersfield—Co. Supvrs. adopted resolution to improve county roads. Approx. cost $1,000,000. Specfs. being prepared. Abt. 38 miles roadway, including part of Bakersfield-Taft Hwy. will be constructed. Plans call for 7-in. asph. conc., 18-ft. wide. Another job projected is that bet. Maricopa and 7.65 mi. n. e. of Taft. This work will be 4-in. cement conc., with 6-in. shoulders. Work was suggested by various oil companies who will pay abt. 90% of cost, balance to be assessed against the land.

Cal., Sacramento—State Highway Commission may call for bids in near future for constr. of that section of coast hwy. lying bet. Huntington Beach and Newport Beach. W. W. Patch, Div. Engr.; J. L. McBride, Supt. of Orange Co.

Cal., San Diego—Plans have been prepared by City Engineer F. A. Rhodes for impvt. of 12th St. exten. and Park Blvd. 2408 c. y. earth excav.; 164,267 sq. ft. pavg., with 1½-in. asph. conc. wearg. surf. on 3-in. bitum. base; 866 lin. ft. cem. conc. curb. Wk. to be done under bond issue of $30,000; for impvt. of Imperial Ave. 7,912 c. y. earth excav.; 451 c. y. earth fill; 123,763 sq. ft. paving with 1½-in. Warrenite-bitu. wearg. surf. on 3-in. bitum. base; 1,541 lin. ft. cem. conc. curb; 700 lin. ft. 14-in. double strength conc. pipe; 166 lin. ft. 12-in. d. s. conc. pipe; work to be done, etc., $30,000; for impvt. of Imperial Ave. thru Encanto dist. 4,751 c. y. earth excav., 2,778 c. y. earth fill; 180,832 sq ft. paving with 1½-in. asph. conc. wearg. surf. on 3-in. bitum. base; 121 lin. ft. 18-in. d. s. conc. pipe culvts.; 40 lin. ft. d. s. conc. pipe culvt.; 4 conc. head walls; 1 conc. inlet, 1 conc. catchbasin; 1 conc. retaining wall 78 ft. long, work to be done, etc., $40,000. Council has also adopted resolution of inten. to pave Elm St.—Columbia St. to Balboa Park, comprising 81,257.32 sq. ft. paving with 1½-in. asph. conc. wearing surf. on 2½-in. bitum base; 106 c. y. earth excav.; 426.7 sq. ft. cement conc. walks; 80 lin. ft. cement conc. curb; F. A. Rhodes, City Engr.

Cal., Santa Barbara—$300,000 Santa Ynez Valley paving bond issue carried at recent election. Project calls for 25 miles 6-in. oil macadam roadway, 18 ft. wide. Work will start in about 2 months. Owen H. O'Neill Co., Surveyor.

Cal., Visalia—Co. Surveyor Lawrence Moye has estimated cost of constructing 62.25 miles of road from Camp Nelson over mountain ridge to the Tulare-Inyo County line at Mulky Pass, at $421,745. Rte. will require 2 conc. bridges of 70 ft. and 60 ft. spans, costing $92,320. Roadway will be 14 ft. wide on the hillside and 16-20 ft. on the level. Wider roadway will be surfaced with 12-inch decomposed granite.

Fla., Avon Park—City will pave with asphalt, portions of Winthrop, Charles, LaGrande, Verona, Pleasant, Church, N. Main, Central, Butler, Forest, Pine, Walnut, Fairfield, Tulane, Circle, Highland Streets; also widen 9-ft. asph. streets to 16-ft.: Lake, Main, Laurel, Rest. Will surface following streets with clay: Palmetto, Highlands, Winthrop, Thomas, Charles, LaGrande, Glenwood, Prospect, DeSota, Anoka, Canfield, Bell, State, Verona, Castle and Letela. Will expend $180,000. Jno. Hood, Engr.

Fla., Deland—Volusia County considering bldg. 10 miles hard surfaced road from Lake Helen to Osteen and St. Johns River bridge at Osteen. $110,000 bonds voted.

Fla., Key West—Monroe County Commrs. plan to construct overseas highway from mainland to Key West. $300,000 bond issue contemplated.

Fla., Ft. Lauderdale—Broward County plans to construct road from Dade County line northward to Deerfield, to connect with Fed. road to be built thru Dade County from Miami. $100,000 bond issue planned.

Fla., Ft. Myers—Lee County plans to build hard surfaced roads. Considering $1,200,000 bond issue.

Idaho, Boise—Proj. statement filed with Bureau Pub. Rds. for proposed hwy. impvt. in Kootenai Co., bet. Cataldo and the Montana State line which involves a mileage, outside of towns, of 23.7 mi. As soon as approval is received the State will let grading and sub-grade surfacing contracts at early date as practicable this Fall. Paving will be deferred until the Spring break-up. Section A and B bet. Kellogg and Wallace; also Wallace and Willow Crk., 1½ miles east of Mullan, will be paved with either bitum. or straight conc. type. Altern. bids will be requested on these; that portion bet. east end of Pine Crk. to west end of Kellogg pav-

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

ing, or a dist. of 3.27 miles, will be surfaced with crushed rock, as will likewise the section from the Kootenai Co. line to west end of Pine Crk. Total expenditures for all these sections, $633,292; Fed. Aid will be requested to extent of $367,309.

Miss., Tupelo—City plans to lay 125,000 sq. yds. asphalt pavement. $160,000 bonds voted. D. W. Robbins, Mayor.

Neb., Wymore—Ord. passed for paving 32 blocks new residential paving. $120,000. Detailed information from City Clk.

N. Dak., Bismarck—Federal Government has approved plans for constr. of project thru Berthold reservation, thru Bad Lands, west of Sanish. Est. cost $80,000. For detailed information address State Hwy. Commission, Bismarck.

S. Car., Laurens—$250,000 bonds voted by Laurens Co. for bldg. and improving 4 roads here. For detailed information address County Commrs.

S. C., Spartanburg—State Hwy. Dept. will soon receive bids for hard surfacing National hwy. east of City. Est. Cost, $150,000.

Tex., Breckenridge—State Hwy. Comn., Austin, granted $222,323 St. and Fed. Aid to Stephens County for building 15.83 miles Bankhead Hwy. with 2-in. asph. conc. top; extending west from Palo Pinto County line. J. C. Rollins, Res. Engr. and E. F. Ritchey, Co. Judge, Breckenridge, Tex.

Tex., Bonham—Fannin County will soon receive bids for bldg. 7.35 miles 18 ft. Bates section of concrete rd. on State Hwy. No. 5, Windon Rd. Dist. 23, Fannih Co. Est. cost, $290,000. Pinckney B. Price, Engineers, Honey Grove, Tex.

Calhoun, Tex.—McLean Co. plans to construct roads here. Bonds in amount of $350,000 voted.

Tex., Center—Shelby County plans to construct 21 mile state hwy. No 35 bet. Thompson and Joaquin. Est. cost, $19,918. F. A. $73,000. Titus & Dillon, Co. Engrs. and D. R. Taylor, Co. Judge, Center.

Texas, Conroe—State Highway Dept. plans to construct 22.13 mi. State Hwy. No. 19 in Montgomery Co. from Wills to Harris Co. line. Est. cost $190,000. W. J. Kelly, Co. Engr., Conroe; W. A. Lee, Co. Judge.

Tex., Ft. Worth—U. S. Bureau of Pub. Rds., plans to build and improve 3 roads as follows: Sutton Co., 22.7 mi. from Sonora to Edwards Co. line. Est. cost, $147,000; F. A., asked, $30,000; Colling Co., 6 mi. Exall hwy. Est. cost $321,000, F. A. asked $150,000; sec. of rd. extending 8.1 mi. thru So. Texas from Bastrop Bayou to Oyster Crk. bayou, est. cost $97,831., F. A. asked, $48,915.

Tex., Georgetown—State Hwy. Comn., granted $65,000 aid to Williamson Co. for bldg. 6.5 miles state highway No. 2 bet. Hutton and Round Rock. Est. cost, $130,000. R. A. Nichols, Co. Engr. and F. D. Love, Co. Judge, Georgetown, Tex.

Tex., La Grange—Fayette County plans to build 14 miles St. Hwy. No. 3 D—La Grange to Colorado Co .line—at approx. cost of $150,000; granted $75,000 Fed. Aid. Capt. A. Schafle, Co. Engr., J. P. Ehlenger, Co. Judge.

Tex., Laredo—City plans street paving. $200,000 bonds voted. L. Villegas, Mayor.

Tex., Marlin—Falls County will build 14 miles State Hwy. 44 from Ellis Lane to Wilson County line via Rosebud. Est. cost approx $200,000. J. P. Wehring, Co. Engr., Lott, Tex., and W. T. Hummicult, Co. Judge.

Tex., Mexia—City plans paving. $50,000 bonds voted.

Tex., Palo Pinto—Palo Pinto County will receive bids within 30 days for bldg. 3.37 miles 18-ft. bitum. mac. road on Bankhead Hwy. from Straw to Eastland County line. Est. cost, $60,000. E. L. Pitts, Co. Judge: G. W. Courter, Co. Engr., Palo Pinto.

Tex., Pecos—Reeves County plans bldg. 14 miles, 18-ft. gravel rd. on Bankhead Hwy., extending west from Pecos River, F. A. P. Est. cost $101,741. S. S. Posey, Res. Engr. and J. F. Ross, Co. Judge Pecos.

Tex., Sonora—$175,000 aid granted to Sutton Co. for bldg. State Hwy. No. 4 and 27. A. Johnson Co. Judge, Sonora, Tex.

Tex., Wichita Falls—Wichita County plans bldg. 6 miles conc. pavement on State Hwy. No. 30. State aid granted in sum of $90,000. J. W. Jebell, Co. Engr., Wichita Falls; D. B. Sartin, Co. Judge.

W. Va., Spencer—Roane County will receive bids soon for grading and draining 12 miles project in Geary District. Plans at Court House here.

SEWERAGE AND SEWAGE TREATMENT

Ala., Opelika—City considering constr. of complete sewerage system. Est. cost, $50,000 to $75,000.

Ariz., Chandler—Election will be held in September to vote on $145,000 bond issue to provide sanitary sewer system, light and power system; also water system.

Ont., London—Plans being prepared for extensions to sewers. Est. cost, $300,000. W. P. Near, City Hall, Engr.

Ont., Niagara Falls—Stamford Twp., will vote for $281,000 bonds for sewerage system. M. Kerr, Ferry Street, Engr.

Ont., Toronto—Plans being prepared for large san. sewerage sys.; in northern section of City; conc. brk. and tile, $2,811,700; also concrete disposal plant, $1,000,000. R. C. Harris, City Engr.

Fla., Bartow—$90,000 bonds voted here for san. sewerage system. Cons. Engrs., Burns & McDonnell, Interstate Bldg., Kansas City, Mo.

Fla., Daytona—City will vote Oct. 2 on $260,000 bonds; $100,000 for sewer construction and extensions; $100,000 for water works and $10,000 for part payment on fire station; also $200,000 for streets.

Kans., Great Bend—Prelim. plans being made for rebldg. san. sewerage system. Est. cost, $80,000. Ruckel Engrg. Co. Hutchinson, Engr.

Kans., Topeka—Survey being made of entire City to establish needs. W. E. Baldry, City Engr., in prelim. estimate states City requires 176 miles sewers. C. A. Haskins, 3929 Oak Street, Kans. City, Mo., Engr.

La., Alexandria—City has authorized $295,000 bond issue; $195,000 for municipal impvts., including street and sewer construction.

La., Shreveport—Election Oct. 2nd to vote on $1,000,000 bonds for sewer and water impvts.

Mich., Springwells—Plans being completed for laterals and sewer arm in Assessment districts Nos. 18 and 22, 10-30 in. vit crock and concrete pipe. Est. cost, $100,000. A. Roth, 2348 Penobscot Bldg., Detroit, Engr.

Neb., Kearny—Prelim. plans being prepared for storm sewerage system. Est. cost, $170,000. Burns & McDonnell, Interstate Bldg., Kans. City, Mo., Engrs.

N. J., East Orange—City considering storm water sewer known as Elizabeth river drain, 1 mile long, mostly 72 ins. rein. conc. pipe. Est. cost, $125,000. W. D. Willigerod, City Hall, Engr.

N. J., Westville—Boro Council plans to construct new sewers at cost of $170,000. C. W. Letzgus, 509 Market St., Camden, Boro. Solicitor.

N. Y., Binghamton—Plans being made for about 5 miles 5-ft. surf. water sewer and 15 in. san. sewer along Trout brook—Glenwood Crk. to Chenango River. Est. cost, $200,000. W. E. Weller, City Engr.

N. Y., Rochester—City plans sewers in 6,700 ft. Highland Ave., at cost of $87,000; 5,800 ft. Rand St. and Steko Ave., stormwater outlet, $47,000. C. A. Poole, City Engr.

Ohio, Barberton—City will soon receive bids for East Side interceptor sewer. Est. cost, $285,000.

Ohio, Marion—Plans election to vote on $190,000 bonds for storm water sewers in East and West Districts. T. Scathers, City Bldg., Engr.

Tenn., Huntington—City contemplates installing sewer system. Est. cost, $85,000.

Va., Richmond—Com. Council has adopted resolution providing for bond issue of $3,000,000 for rehabilitation of Shockoe Creek Valley; $180,000 for constr. of storm sewer system in West End; also $110,000 for storm sewer in Douglas Court section.

Va., Westhampton—(R. Sta. Richmond) Dr. B. B. Bagby interested in installation of sewer system to cost about $100,000.

Wis., Madison—City plans new sewerage system and disposal plant in South Madison Dist. K. C. Buser, City Clk. Engineer not selected.

WATER SUPPLY AND PURIFICATION

Ark., Marianna—City Council contemplates rebuilding and enlarging water plant. Est. cost, $200,000.

Cal., Beverly Hills—$400,000 bonds voted here for water system.

Cal., Pasadena—$200,000 water works bonds voted

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

here. Funds derived from sale of bonds will be used to sink wells, in order to increase local water supply. Work will involve 3 miles pipe line; 6,000,000 gal. reservoir, 2 booster pumps and drill 1 more well. Part of the funds will be used to purchase water rights to 40 acres in northern section of San Gabriel.

Cal., Watts—Conservative Water Company plans 10 miles cast iron and screw pipes, new pumps and meters. Est. cost, $150,000.

Ont., Cochrane—$110,000 bonds will be issued here for impvt. and alteration of water system.

Fla., Tampa—City will expend $1,273,000 on municipal water works. W. Lesey Brown, Mgr. Nicholas S. Hill, Engr., 112 E. 19th St., New York.

Ga., Atlanta—Finance Comm. has recommended new bond issue of $1,500,000 to City Council for water works hydro-electric plant and extension of City water mains. It provides $1,100,000 for new impounding dam and hydro-electric plant; also $400,000 for water main extensions to care for City's rapidly increasing population. Plans for new development call for dam across Chattahoochee river some 2 mi. above present pumping station. Intake water main will be extended into river behind the dam and through this water will be carried by force of gravity to present water wks. Turbines on either side of dam will utilize river's flow to generate elec. power. This will be carried by elec. cables to present plant where, connected up with dynamos, it will suplant steam engines now in use at pump'g. sta. Capy. of new main will be approx. $80,000,000 gals. water per day; new sys. of mains, when completed, will be 72,000,000 gals. W. Zode Smith, in charge of Water Works.

Ill., Forest Park—(Oak Park, P. O.)—Town considering laying mains and constructing reservoir. Est. cost, $180,000. Suhr & Berryman, 105 N. Clark St., Chicago, Cons. Engineers.

Ill., Litchfield—Plans have been made to improve water system. Est. cost, $200,000.

Ia., Iowa City—Granted 25-year franchise at recent election. About 12 miles water mains. Est. cost, $300,000. Geo. W. Ball, Pres.

La., Shreveport—$1,000,000 bonds voted for water and sewer improvements.

Maine, Bangor—Council will be requested to authorize bond issue in sum of $135,000 for constr. of impvts. at water works dam.

Md., Baltimore—Mayor and Council are preparing plans to lay mains in various sections of City; cost, $630,000. W. A. Megraw, Water Engr.

Mich., Detroit—Board Water Commrs. making plans under direction of G. H. Fenkell, General Manager, for main extensions as follows: 3½ miles 24-in. pipe in 8-mile rd., 2 miles 12-in. in Ridge Rd. and 2 miles 12-in. in 10-mile Rd. Est. cost, $140,000. T. H. Leslie, Water Works Park Engr.

Minn., Winona—$200,000 improvements will be made here to water works.

Mo., Kansas City—Fire and Water Board has accepted report of Fuller and Maitland, Construction Engineers on water system, to cost about $19,877,000. Bldg. program and estimates of cost, together with proposed dates of opening bids are as follows: Oct., 1923, main pressure tunnel, $1,527,000; branch pressure tunnels, $1,906,000; main pumping and power plant machinery for right lift station, $1,051,000—total cost, $4,484,000; March, 1924, high lift sta. substructs., valves, piping and equalizing reservoir, $1,508,000; purification works, grading, basins and substructs, railroad siding, $4,660,000—total cost, $6,168,000; Oct., 1924, high lift sta. superstructs., stack and coal handling equipment, $560,000; pressure tunnel, drainage and control arangements, $253,000; discharge mains, $2,974,000—total cost, $3,787,000; May, 1025, high lift sta. steam auxiliary equipt., $302,000; low lift and secondary stas. pumping and elec. equipment, $731,000—total, $1,033,000; Sept., 1925, intake and low lift sta. substruct. and grit chamber, $661,000; purification works superstruct., $679,000; high lift sta., rds., works, etc., $36,000; river protection works, $575,000—total cost, $1,951,000; June, 1926, purification wks., filter and chem. equipment, rds., walks, etc., $854,000; will also expend from 1925 to 1926 for extensions to distribution systems and impvt. of existing works, $1,600,000.

Neb., Kearney—Prelim. plans being prepared for water works system. $75,000. Burns & McDonnell, Interstate Bldg., Kansas City, Mo., Engrs.

N. Y., Albany—Upon the recommendation of Allan Hazen, Cons. Engr., Com. Council will be asked to appropriate $600,000 for enlarging filtration plants.

N. Y., Fredonia—Plans being made for new reservoir near Shumla on east bank of Canaday Creek; also new dam and 16-in. mains, $185,000. If 12-in. main is used it will cost $148,000. W. Shelto, City Hall,, Engineer.

N. Y., Hammondsport—Bd. of Village Trustees plans to install new water supply system. Est. cost, $100,000 to $125,000. J. H. Brown, Supt., Public Works and Safety.

N. Y., Jamestown—Election planned to vote on $150,000 bonds for renewal of mains throughout City. L. O. Bergman, City Engr.

N. Y., Niagara Falls—City contemplates extending water facilities, by addition of 16 new filters at est, cost of $200,000. W. Bennett, City Engr.

N. Y., Oneida—Water Board has retained N. Hill, Jr., Engr., 112 E. 19th St., New York City, to investigate and report on new water system. Est. cost, $1,500,000 .

N. Y., Rochester—Taxpayers here have voted approval of proposed Lake Shore water dist., at cost of $180,000.

N. C., Laurinburg—City contemplates water and sewer impvts. Est. cost, $150,000. May vote bond issue in this amount.

N. Dak., Bismarck—$640,000 will be expended on constr. of City water works.

Ohio, Ashtabula—Ashtabula Water Company plans to extend water system. Est. cost, $150,000. Engineer not announced.

Okla., Holdenville—Election will soon be called for purpose of voting on $85,000 bond issue. It is proposed to enlarge filter plant, purchase new pumping equipt. and make water main system extens. MacIntosh Co., 1st National Bldg., Okla. City, Engrs.

S. C., Greenville—Greenville City Water Works Comn. has retained engineers to make survey for securing water supply from Blue Ridge mountains. $300,000 bonds voted for additional water supply.

Texas, Dallas—City contemplates creation of lake to be formed by dam on Mountain Crk. nr. Oak Cliff, 40,000,000,000 gal. capa. (primarily for pleasure resort but could be used for water supply if needed). Est. cost, $250,000. E. A. Kingsley, City Engr.

Tex., Stamford—Jno. B. Hawley and E. E. Sands, Ft. Worth and Houston, have been retained to design sewerage disposal plant for Stamford. Est. cost of $30,000; also to design filtration plant for Sweetwater, Texas. Est. cost, $35,000.

Wash., Longview—Longview Public Service Co. preparing to install filling and treating plant near Longview well No. 2. Water here contains taint of iron and it is expected to remove this by lime treatment.

Wash., Seattle—Allan R. Moore, Mt. Vernon, has made application to Martin Chase, State Supvr. of Hydraulics at Olympia, for water appropriation for a $100,000 hydro-electric development. He asks for a 144 second ft. of waters of Swift Crk., a tributary of Baker River, Skagit Co., and plans installation of a diversion dam of conc., 30 ft. high and 160 ft. long on top, 100 ft. at bottom, with spillway over rim rock. Head of from 330-660 ft. will be utilized, with turbine power wheel and 5000 h. p. is est. development.

Wash., Spokane—Following appropriations requested for impvts. to Spokane Water system for year 1924: New pump to replace No. 5, $17,000; trenching mach. for digging ditches, $10,000; backfilled for excav., $3,000; wooden water main replacement, $40,000 and replacing Herbert private water system, $69,600. Total, $139,600.

W. Va., Charleston—City will expend $38,047 to enlarge So. Hill water system as follows. One 6-in. line from Laurel Ave. thru Spring and Bridge Aves. and 6-in. line in Bridge and Cedar Aves.—Spring to Chestnut; 4-in. line in Crescent Ave.; 13 additional fire hydrants; 150,000 gal. capy. tank, with 12-in. discharge line; 200-gal. per min. capy. pump, including foundations, etc. For further detailed information address the Mayor.

Wis., Milwaukee—City contemplates laying 13,000 ft. 54-in. c. i. pressure main in Chambers Street—end of present main to beyond City limits. Est. cost, $300,00. J. Schwada, City Hall, Engr.

Wis., Athens—Special election will be held for purpose of voting on $73,000 bond issue for water and sewerage system.

BUYERS' GUIDE

Pumps.
De Laval Steam Turbine Co.
Evinrude Motor Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Special Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surface Heaters
Chausse Oil Burner Co.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Little Giant Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Tool Heaters, Asphalt
Chausse Oil Burner Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck
The Hug Co.

Valves.
Coldwell-Wilcox Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
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—Asphalt Tool Wagon
—Bar Cutters and Benders
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—Brick Rattlers
—Catch Basin Covers
—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
—Cranes, Locomotive
—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
—Industrial Cars
—Industrial Track
—Manhole Covers
—Mixers, Building
—Mixers, Hot
—Mixers, Paving
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—Motor Trucks (over 3 tons)
—Oil Distributors
—Portable Conveyor
—Portable Drilling Rigs
—Pile Drivers
—Pumps
—Reinforcing Steel
—Road Drags
—Road Forms
—Road Graders
—Road Mesh
—Road Planes
—Road Plows
—Road Rollers
—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
—Scrapers, Power
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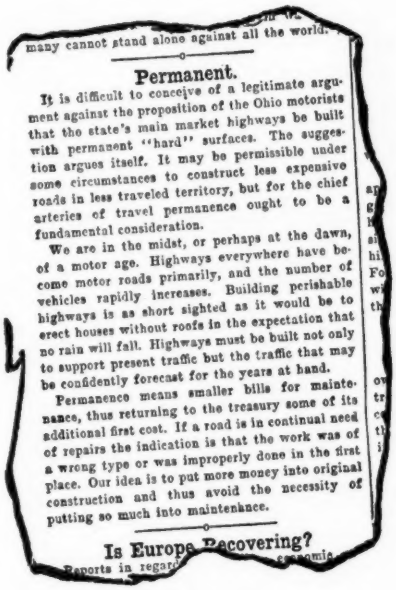
—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
—Stone Screens
—Stone Spreaders
—Surface Heaters
—Tampers, Road
—Tractors
—Trailers
—Turntables
—Unloaders, Car
—Wagon Loader
—Wheeled Scrapers
—Wire Mesh

No Brick Pavement Ever Wore Out From the Top Down



many cannot stand alone against all the world.

Permanent.

It is difficult to conceive of a legitimate argument against the proposition of the Ohio motorists that the state's main market highways be built with permanent "hard" surfaces. The suggestion argues itself. It may be permissible under some circumstances to construct less expensive roads in less traveled territory, but for the chief arteries of travel permanence ought to be a fundamental consideration.

We are in the midst, or perhaps at the dawn, of a motor age. Highways everywhere have become motor roads primarily, and the number of vehicles rapidly increases. Building perishable highways is as short sighted as it would be to erect houses without roofs in the expectation that no rain will fall. Highways must be built not only to support present traffic but the traffic that may be confidently forecast for the years at hand.

Permanence means smaller bills for maintenance, thus returning to the treasury some of its additional first cost. If a road is in continual need of repairs the indication is that the work was of a wrong type or was improperly done in the first place. Our idea is to put more money into original construction and thus avoid the necessity of putting so much into maintenance.

Is Europe Recovering?

Reports in regard

A forceful paving preachment from the May 16 issue of the Cleveland Plain Dealer.

FOR MODERN TRAFFIC CONDITIONS VITRIFIED

Brick PAVEMENTS

IF there is a faulty brick pavement in your vicinity, remember this:—the chances are at least one hundred to one that either a poor foundation or bad drainage conditions wrecked it.

The fire-hardened brick on the surface, you can easily assure yourself, shows little or no wear except where failures *below the surface* have thrown individual bricks out of position. The perfect condition of the great bulk of the brick is ample proof of where the fault lay.

An enduring, low-upkeep pavement is a combination of three factors:—*first,* thorough and intelligently planned drainage; *second,* an adequate, well-built foundation; *third,* a vitrified brick surface.

Without the first two factors no road surfacing material can render lasting service. Without the last no street or road can withstand modern traffic and hold a smooth riding surface without creating a continuous drain on the public treasury for endless maintenance and repair charges.

Public sentiment on public paving jobs is accurately reflected by the newspaper editorial here reproduced.

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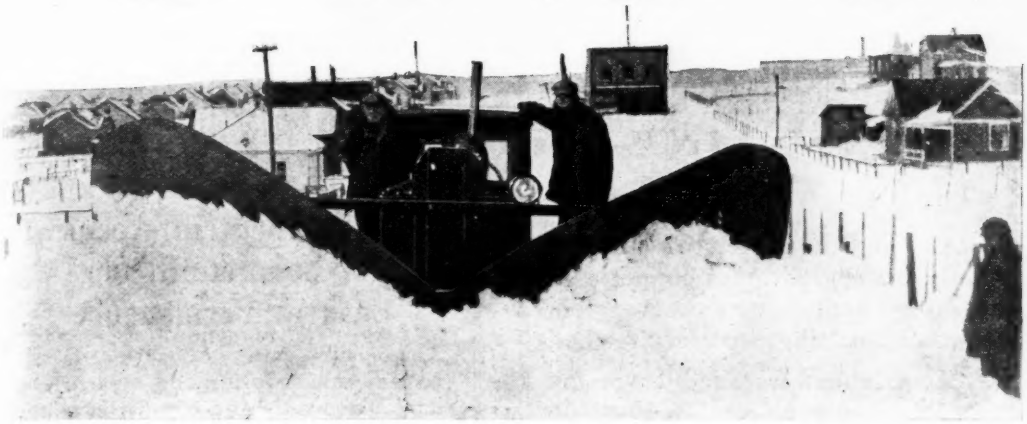

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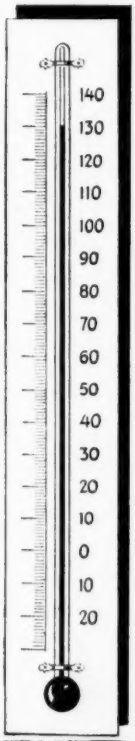

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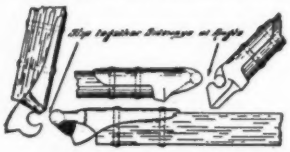

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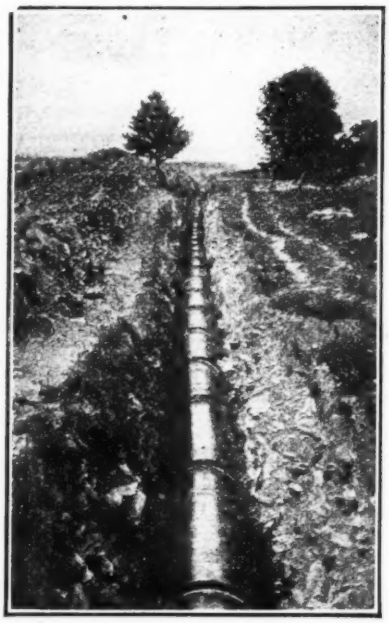

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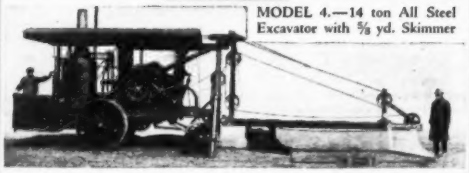

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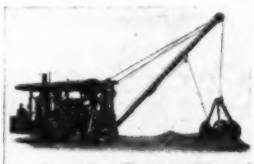

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